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STEEL FOR 1949

Steel and oil are two vital sinews of modern mechanized warfare. This fact was brought home to both industries when, during the war, the demand for steel and oil rose to unprecedented heights and necessitated drastic curtailment in their use.

Oil, despite its importance, received scant consideration from Washington when it came to steel. The industry had to get along as best it could on a supply so meager that each permit for the drilling of a well was scrutinized by Washington to insure the steel being put to the most effective use in maintaining the production of crude oil. Restrictions on steel extended also to refineries to insure its more effective use for the manufacture of essential petroleum products. All this has had the effect of making the oil industry keenly conscious of the important part steel plays in carrying on its operations.

Of the steel scarcities still prevailing, even three years after the war, tubular goods are perhaps the most keenly felt. A government survey was made recently of steel production and steel capacity of oil country goods and line pipe. The facts developed are significant. They reveal a remarkable record made by the steel industry in increasing the supplies of steel to the oil industry. The production of oil country goods, consisting chiefly of tubular goods used in well drilling, reached 1,674,876 tons in 1948, sufficient for drilling 39,121 wells. Based on an anticipated 43,000 wells in 1949, the estimated requirements are 1,840,400 tons. This is about 4000 more wells than were drilled in 1948.

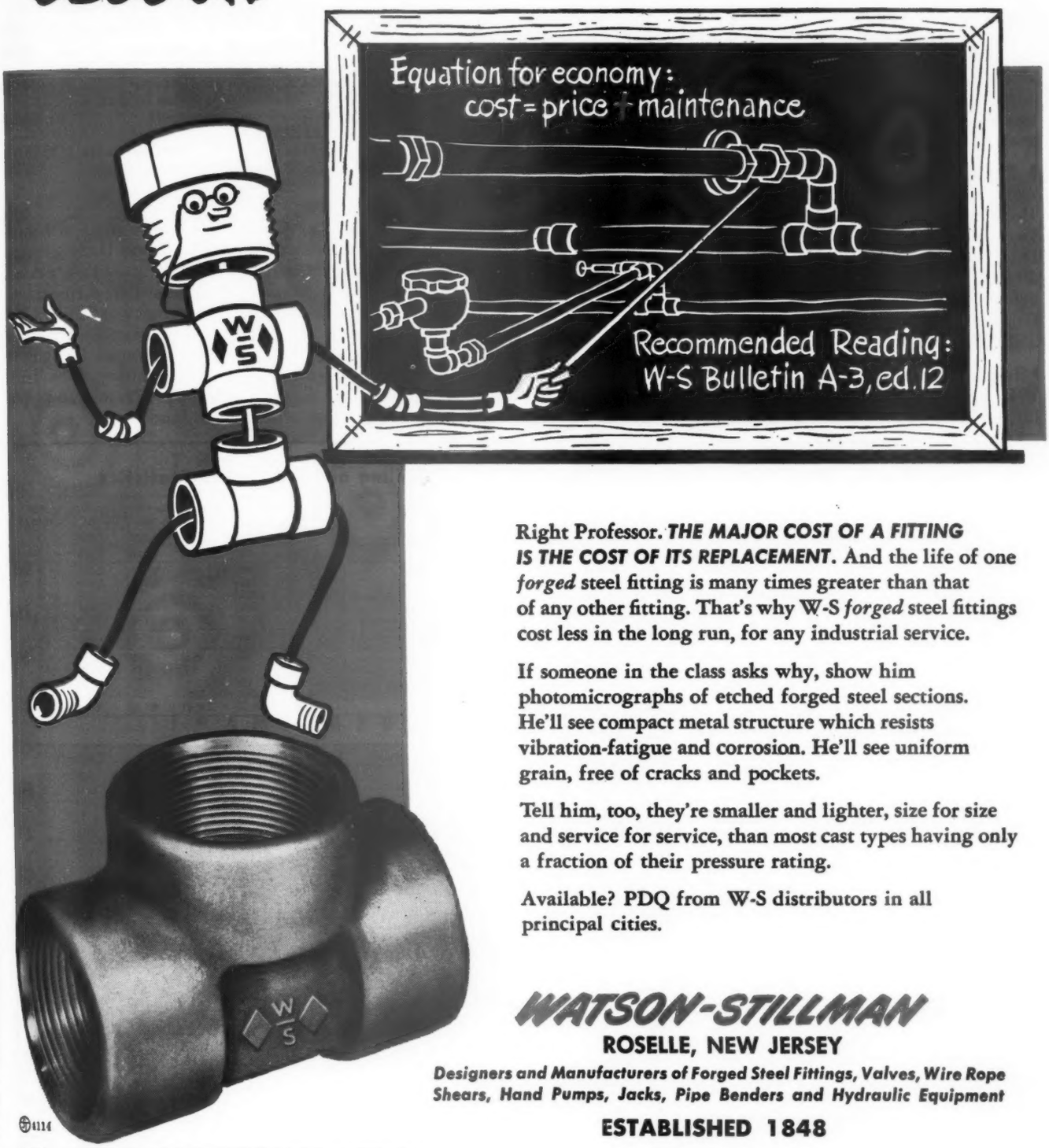
The estimated average amount of steel per well in 1948 was 42.8 tons. In the period 1938 to 1941, the yearly average production of oil country goods was 1,041,014 tons, when a yearly average of 30,200 wells was drilled in the United States. For the four years, 1942 to 1945, the average yearly production of oil country goods was 844,169, when an average of 23,693 wells a year was drilled. Since 1945 the yearly production of oil country goods has more than doubled. On the basis of anticipated production and 42.8 tons per well, there will be steel for 42,128 wells in 1949.

Notable increases have also been made in the production of line pipe. During 1948, production of line pipe was 2,221,084 tons, an increase of more than 200 per cent over the prewar yearly average. For 1949, the estimated production of line pipe is 2,553,517 tons, or 246 per cent more than the prewar average. Even with this increase in the production of line pipe, all the requirements of the oil and gas industries as estimated by the Interior Department of the Government may not be met. Nevertheless, these are substantial increases in the production of oil country goods and line pipe, the benefits of which will be felt by the oil industry in 1949.

The facts developed by the survey reveal the tremendous strides made by the steel industry in narrowing the gap between production and demand in oil country goods.—K.C.S.

A FITTING LESSON

FORGED FITTINGS LAST



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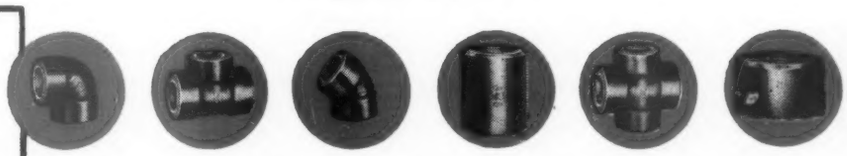


SOLD THROUGH LEADING DISTRIBUTORS

National Petroleum Situation

Demand Eases Stocks. Better demand for fuel oils in February effected an easement in the recently burdensome stock position. Furthermore, curtailed crude production and sharply reduced refinery operations contributed to a combined draft on stocks of about 11,863,000 bbl. Stocks of all refined products dropped 17,588,000 bbl in February, while crude stocks rose 5,725,000 bbl. Refined products stocks are 35 per cent above last year, but represent supply of only eight days more than a year ago. Colder weather this month and increased motor travel beginning next month may be decisive factors in immediate supply outlook.

Production Curtailment. Crude production in February averaged about 5,404,000 bbl daily, a decline under December of about 284,000 bbl daily. Texas decline since December was 188,000 bbl daily; Kansas was off 33,000 bbl; Oklahoma 25,000 bbl, and Mississippi output was 20,000 bbl lower. Further reductions in production allowables have been ordered this month by Texas, Kansas, Louisiana, and Oklahoma. Combined cut-backs are about 252,000 bbl daily.

Import-Export Figures. Imports exceeded exports in 1948 by 52,755,000 bbl. However, if bunker oils used by foreign trade vessels are added to exports there was actually an excess of exports over imports of 30,804,000 bbl. Reclassification of Bureau of Mines figures results in excess domestic supplies in 1948 of 137,306,000 bbl. The figures tell the story:

1948 Supply and Demand Statistics

Domestic		*Foreign Trade*	
Domestic production	2,162,119,000	Imports	187,709,000
Domestic demand	2,108,372,000	Exports	134,954,000
Less bunker oils	83,559,000	Plus bunker oils	83,559,000
Net domestic demand	2,024,813,000		
Excess domestic supply	137,306,000	Actual exports	218,513,000
Less excess exports	30,804,000	Excess exports	30,804,000
1948 stock increase	106,502,000		

Drilling Off 22 Per Cent. Well completions in February were about 22 per cent under January. Daily average well completions in February were at the rate of 84, against an average of 108 in January. All wells drilled, including service wells, aggregated 2,358 in February, against 3,338 in January. Wildcat operations in February were 28 per cent below the January rate. Wildcats averaged 13 daily in February, against an average of 18 in January. New drilling operations at the close of February were about 13 per cent below the number reported on January 31.

Comparative Statistics, February, 1949

*All figures are computed on a Bureau of Mines' Basis**

	Feb. 1949℗	Jan. 1949℗	Feb. 1948	This year to date	Last year to date	Per cent change
Total supply, all oils	181,896	201,923	181,238	383,819	370,972	+3
Daily average	6,496	6,513	6,250	6,505	6,183	
Total demand‡, all oils	193,759	181,899	181,813	375,658	381,576	−2
Daily average	6,920	5,868	6,269	6,367	6,360	
Change in stocks (total)	−11,863	+20,024	−575	+8,161	−10,604	
Crude supply*	164,560	183,745	163,578	348,305	335,786	+ 4
Daily average	5,877	5,927	5,640	5,903	5,596	
Crude demand‡	158,835	181,899	162,001	340,734	334,209	+ 2
Daily average	5,673	5,870	5,586	5,775	5,570	
Crude stocks	263,825	258,100	231,419	263,825	231,419	+14
Days supply	46	43	41	46	41	
Natural gasoline production	12,355	13,500	11,344	25,655	23,341	+10
Daily average	441	435	391	434	389	
Motor fuel production	71,910	82,780	67,518	161,690	141,330	+15
Daily average	2,568	2,670	2,328	2,740	2,355	
Gasoline yield, per cent	42.4	42.3	37.7	42.3	39.1	+3.2
Motor fuel demand‡	64,548	67,905	58,223	132,453	121,846	+ 8
Daily average	2,304	2,190	2,008	2,245	2,030	
Motor fuel stocks	122,470	115,090	106,908	122,470	106,908	+14
Days supply	53	52	53	53	53	
Fuel oil production	62,915	72,180	70,230	135,095	143,375	− 6
Daily average	2,246	2,328	2,422	2,289	2,389	
Fuel oil demand‡	92,980	82,375	86,251	176,355	179,533	− 2
Daily average	3,321	2,760	2,974	2,989	2,992	
Fuel oil stocks	127,460	149,450	77,746	127,460	77,746	+64
Days supply	39	57	26	39	26	
Refinery still runs	150,680	174,210	156,014	324,890	321,810	+ 1
Daily average	5,381	5,620	5,380	5,506	5,363	
All refined stocks	349,252	366,840	258,777	349,252	258,777	+35
Days supply	50	62	42	50	42	

Current Crude Oil Prices

U. S. Average	$2.57	Louisiana	$2.62	**Basic crude prices:**	
Texas	2.61	Arkansas	2.43	Oklahoma-Kansas (36 gr.)	$2.57
California	2.42	New Mexico	2.40	Texas Gulf Coast (36 gr.)	2.86
Oklahoma	2.63	Mississippi	2.42	East Texas	2.65
Kansas	2.62	Illinois	2.76	West Texas (36 gr.)	2.44
		Other states	3.00	California Signal Hill (26 gr.)	2.41
				Pennsylvania, Bradford	4.00

Drilling and Production Statistics

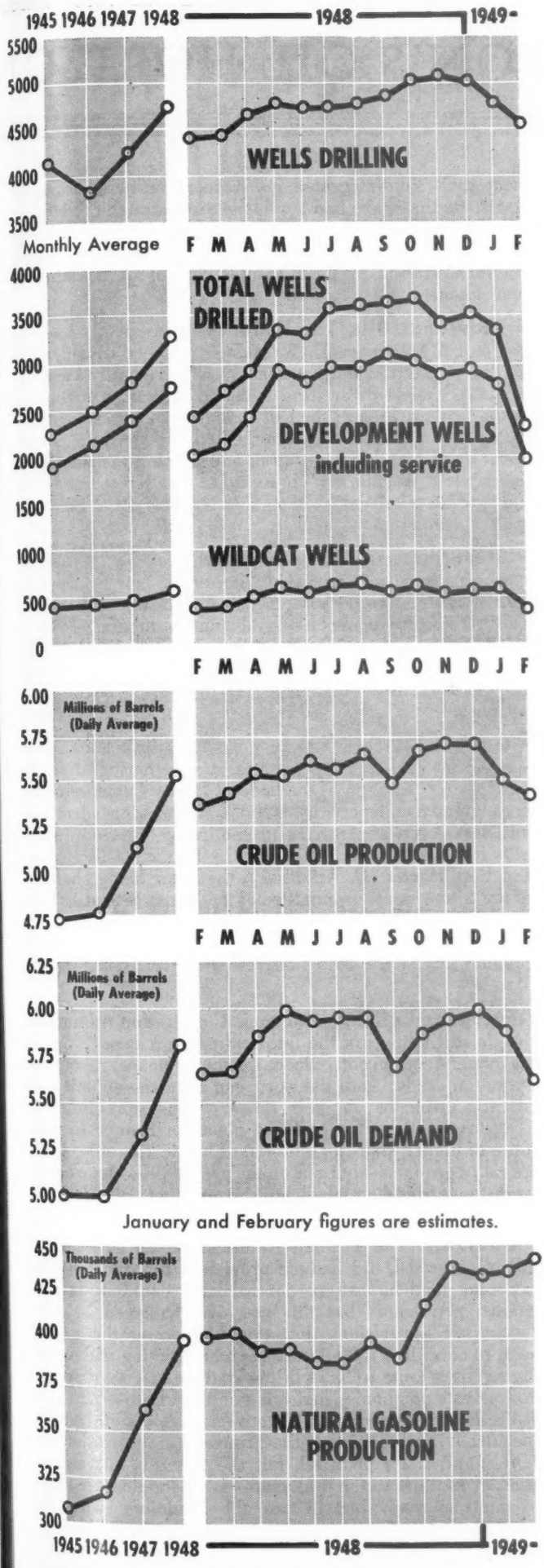
	Feb. 1949℗	Jan. 1949℗	Feb. 1948	This year to date	Last year to date	Per cent change
Wells drilling	4,526	4,770	4,400	4,526	4,400	+ 3
Total wells drilled	2,358	3,338	2,393	5,696	5,420	+ 5
Development wells	1,880	2,645	1,864	4,525	4,169	+ 8
Oil	1,309	1,842	1,329	3,151	2,969	+ 6
Gas	185	217	162	402	369	+ 9
Dry	386	586	373	972	831	+17
Per cent dry	20.4	22.8	20.0	21.4	19.9	+1.5
Service wells	104	133	144	237	362	−34
Wildcat wells	374	560	385	934	889	+ 5
Oil	57	81	62	138	122	+13
Gas	9	10	18	19	37	−49
Dry	308	469	305	777	730	+ 6
Per cent dry	82.4	83.7	79.2	83.4	82.1	+1.3

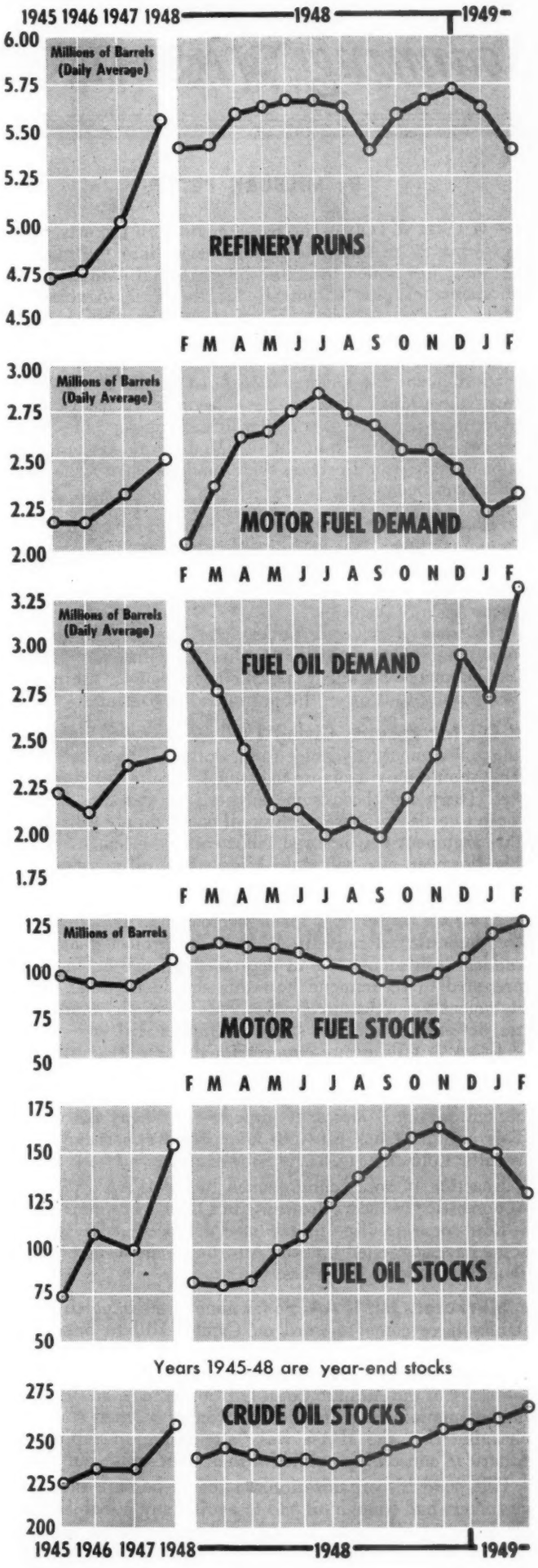
By States

Wells drilled (excl service)	2,254	3,205	2,249	5,459	5,058	+ 8
Arkansas	23	4	28	27	63	−57
California	186	267	213	453	429	+ 5
Illinois	166	184	154	350	327	+ 7
Kansas	197	235	197	432	441	− 2
Louisiana	155	215	123	370	267	+38
Mississippi	21	29	32	50	67	−25
New Mexico	46	41	32	87	92	− 6
Oklahoma	184	347	260	531	594	−11
Texas	785	1,231	715	2,016	1,607	+25
Other states	491	652	495	1,143	1,171	− 4
Wildcats drilled (incl above)	374	560	385	934	889	+ 5
Arkansas	4	2	7	6	18	−67
California	37	53	25	90	51	+76
Illinois	19	34	33	53	61	−13
Kansas	28	44	30	72	65	+11
Louisiana	17	19	30	36	36	0
Mississippi	3	12	6	15	15	0
New Mexico	7	15	3	22	6	+266
Oklahoma	34	73	52	107	136	−21
Texas	164	234	149	398	371	+ 7
Other states	61	74	60	135	130	+ 4
Daily crude production	5,404	5,485	5,352	5,447	5,317	+ 2
Arkansas	91	91	88	91	85	+ 7
California	943	946	934	944	932	+ 1
Illinois	175	181	174	179	173	+ 3
Kansas	281	305	287	293	288	+ 2
Louisiana	533	525	477	529	473	+12
Mississippi	107	120	118	114	115	0
New Mexico	133	135	128	134	126	+ 6
Oklahoma	425	442	400	434	395	+10
Texas	2,365	2,363	2,396	2,364	2,374	0
Wyoming	130	135	138	132	139	− 5
Other states	221	242	212	233	217	+ 7

*Unless otherwise stated all figures represent thousands of barrels.
‡Total demand, including exports.
¶Revised.
℗—Preliminary.
•Includes domestic production and imports.
Note—January, 1949 Estimates Revised to Reflect Later Information.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.


1945 1946 1947 1948 — 1948 — 1949
WELLS DRILLING
Monthly Average
F M A M J J A S O N D J F
TOTAL WELLS DRILLED
DEVELOPMENT WELLS including service
WILDCAT WELLS
CRUDE OIL PRODUCTION
Millions of Barrels (Daily Average)
CRUDE OIL DEMAND
January and February figures are estimates.
Thousands of Barrels (Daily Average)
NATURAL GASOLINE PRODUCTION


1945 1946 1947 1948 — 1948 — 1949
Millions of Barrels (Daily Average)
REFINERY RUNS
MOTOR FUEL DEMAND
FUEL OIL DEMAND
Millions of Barrels
MOTOR FUEL STOCKS
FUEL OIL STOCKS
Years 1945-48 are year-end stocks
CRUDE OIL STOCKS

Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—The battle against oil imports, already growing more bitter as it edges even into the marketing branch, has boiled over into international politics with the licensing of pipe shipments for the Trans-Arabian Pipe Line.

When the military took an option on 5 per cent of Tapline's capacity in exchange for the government issuing this export license, it amounted to hoisting the American flag over the project. Also, it gave the military a stake in the Arabian oil reserves, which will feed the pipe line, and in the refinery to be built at the Mediterranean end, which presumably would process the crude transported at cost for the government.

Recalls Ickes' Scheme. This deal was enough like Ex-Secretary Ickes' idea of government participation in Middle East oil to start that old fight again. A congressional investigation was suggested by Russell Brown, Independent Petroleum Ass'n of America.

Issuance of this export license for Tapline virtually commits the government to follow through with others because, as Commerce Secretary Sawyer commented, "there would be no point to it, if we did not intend to continue."

Oil for Europe. Giving Tapline the green light means the government has decided that dollar oil from the Middle East should have a chance to compete for the European market. There had been some suggestions that the new line wasn't needed because sterling oil could supply Europe. But this argument was ignored. Shortening the haul from Arabia, however, also will make Middle East oil more competitive with domestic crude in the U. S. market.

Krug on Imports. Interior Secretary Krug believes that the domestic oil industry "should be protected against a sudden rush of imports at depressed prices" but he is not prepared to recommend how this should be done. Krug's statement was welcomed by the IPAA whose fight for import restrictions has run into snags on Capitol Hill.

IPAA is telling any congressional committee willing to listen that the domestic producer won't have the wherewithal to find new oil needed in event of a war that would cut off foreign sources, if imports take away his market. This argument has run into unexpected opposition—from Senator Connally (D, Texas) for example.

Reaction of some congressmen to the IPAA's picturing of domestic producers drowning in a flood of foreign oil was —how come gasoline prices have not been reduced? And some have suggested that the Attorney General or Congress should investigate oil prices.

Marketers Hit IPAA. So far none of the importing companies have come forward on Capitol Hill to oppose restrictions on foreign oil entering the U. S. market. Only opposing witness to date has been Harry Hilts, New York, secretary of the Atlantic Coast Oil Conference, an organization of marketers. Hilts filed a strongly worded statement charging that the IPAA was "attempting to exploit the American consuming public for their own selfish purposes."

Hilts said his organization wanted to be sure that their customers had enough oil and to avoid "any possibility that the price of oil might be bid up because of an artificial scarcity." Non-integrated independent refiners, he added, for some time have had trouble getting enough crude at the posted price, blaming this on the "cartel-like" control over production in some of the oil compact states. For similar reasons, Hilts may back federal control of tidelands oil development.

Tidelands Bill. The White House is gently needling Senator O'Mahoney (D, Wyoming) to speed consideration of the federal tidelands leasing bill, which he introduced "by request." They are fretting over the increasing number of wells being drilled in the Gulf under state leases. Secretary Krug says if federal legislation is long delayed, the government itself may have to step in and develop the submerged lands areas as military oil reserves. But Krug smiles ruefully while admitting, "We would have to get money from Congress for that."

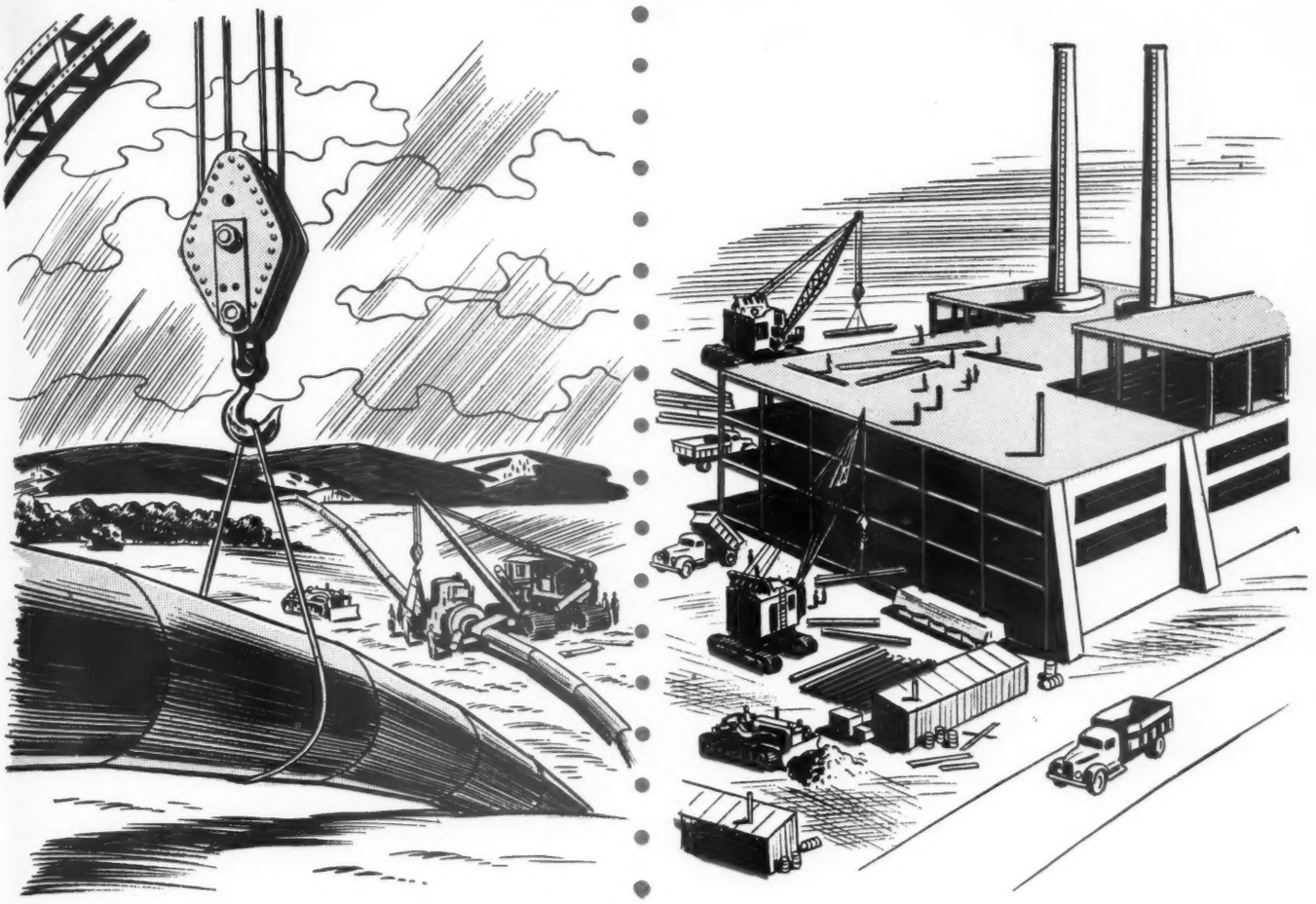
Steel Improves. Krug agrees with Sawyer that the oil-steel situation is considerably improved, but he wants to nail it down. Sawyer says the steel industry will meet or exceed all requirements for oil-country tubular goods in 1949. Krug replies, "That may be true—but why not put it in writing and make it certain, with the steel industry joining together in a voluntary allocations program for this purpose."

Gas Bill. Prospects for enactment of legislation that would specifically exclude the production and gathering of natural gas from jurisdiction of the Federal Power Commission has been greatly enhanced by action of the Independent Natural Gas Ass'n of America in endorsing objectives of the bills for this purpose introduced by Rep. Lyle (D, Texas) and Rep. Harris (D, Arkansas), the latter being chairman of the petroleum subcommittee of the House Interstate Commerce Committee considering the bills. Throughout last session, the INGAA held out for the omnibus gas bill; it couldn't get by the 80th Congress, however, much less the 81st.

European Refining. Economic Cooperation Administration is still sitting on the lid, holding back export licenses on refinery equipment (except for maintenance, repair, and operation needs) until the European countries submit more realistic estimates on their refinery expansion programs. ECA favors plans for building plants in Europe to make more of higher quality gasolines, of lubricating oils, and of specialty products—but not on the grandiose scale proposed by the countries themselves, which would not only meet their own needs but provide an exportable surplus.

Controls. The Truman Administration's anti-inflation bill, as expected, did include provisions for standby price, rationing, and allocations controls that could be invoked against petroleum—but this was overshadowed by other "socialistic" provisions that would empower the government to enter into the oil business, constructing and operating facilities from wells to filling stations if it were decided that private companies had not—or would not—expand to levels deemed desirable by the government. On oil controls, specifically, the position of the Truman Administration is—"Oil supplies are plentiful, but the situation can change, quickly, as it has in the past year—so we should have standby controls ready just in case the pendulum swings the other way again."

FROM PIPE LINES TO PAPER PLANTS



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HIGHLIGHTS in Oildom

While Leveling Forces go into effect to bring supply in line with demand it might be of interest to note there is not much use in getting excited about the over supply of this winter—or not as much—as about the under supply of last winter. The important thing is the fact that demand in 1948 showed an increase of about four per cent from 1947. Many executives and public officials are busily announcing the surplus of oil products and in a way, these very announcements are part of the balance to bring down supply. Government and military oil procurement offices report that they are filling requirements for all products easily. L. Dan Jones, attorney for the Independent Petroleum Association of America, stated to Congress that the world now is producing a surplus of oil and there is no foreseeable exhaustion of United States resources. Earnest O. Thompson, Texas Railroad Commissioner, told Associated General Contractors of America that world production of oil "has already passed by far the present world consuming ability."

Of course, this is what the oil industry promised in 1947 when production ran short. "Give us the steel," said the oil operators, "And we will give you the oil." Although they didn't get all the steel they wanted they have more than kept their promise.

Kansas Commission Fixes Price. For the first time Kansas' corporation commission entered into natural gas price-fixing by setting a temporary well head price for Hugoton field gas at 8 cents per MCF. This is a boost from the previous 5.35-cent average that would increase monthly revenue by about $600,000, if production rate is maintained. Action, paralleling the Oklahoma commission's 7-cent price-fixing order now on appeal to the state supreme court, was taken as a means of preventing waste. The commission is making an investigation to determine the ultimate price to be established.

Trend Toward Independent Gas Industry. Diversified and ever increasing uses of natural gas and derivatives are leading to a more independent status for the industry, according to Dallas' Federal Reserve Bank economist Keith Johnson. The favorable price position of gas as compared to coal and oil has stimulated consumption, particularly by industrial users. As an example, while unit fuel costs of utility companies producing electric energy from coal increased 71 per cent from 1939 to 1947, fuel costs of utilities using natural gas decreased 9 per cent. Natural gas has grown from 4.3 per cent in 1919 to 13.7 per cent in 1947 as a source of energy in the U. S.

Devices Like Geiger Counters are said to be in use by the United States in its search for uranium deposits in oil wells. J. K. Gustafson, manager of raw materials operations of the Atomic Energy Commission, and his assistant, Dr. Phillip L. Merritt, explained that new techniques to find uranium included equipment that could be attached to oil well bores to locate the strategic metal.

Which Way to Jump is a question that the oil industry has a hard time answering. While United States government officials bring suit against so-called monopolies that hold the price of oil up in the nation, the state of Texas has charged 10 major oil companies for alleged collusion in stablizing the price of gasoline. Eight are said to have conspired to defeat a 30¢ increase in the price of crude oil.

Flaring Control by the Texas Railroad Commission passed through one hazard last month when the Texas Supreme Court ruled that it has the right to close the Heyser Oil Field in Calhoun and Victoria counties to stop wasteful flaring of gas that comes to the surface in producing oil. The court overruled a temporary injunction granted by the District Court against the Railroad Commission. While the court order applies only to one field the state attorney general said he will proceed against operators in 14 other fields. The Commission ordered shutdowns of about 30 fields where venting of natural gas exceeded 10,000,000 cu ft daily.

Most Carefully Read Publications are annual reports. In the oil company reports each year we find the progress made by each organization, not only on the financial side, but in bringing new reserves in crude oil production and/or refinery runs and pipe line runs. We learn also of the great construction projects completed during the year and those planned for the year to come. They are reports of the drama of American business.

The books themselves vary from company to company but some of the best achievements of the printing industry are found among the annual reports.

Canadian Oil Men have become the most enthusiastic group on the continent. In our great neighbor state demand has always been met by about 90 per cent imports and so far, Canadian operators do not know what over supply means. One evidence of this enthusiasm is the statement by Theodore A. Link, a prominent Canadian geologist, that Alberta's oil industry should eventually rival that of Oklahoma, Kansas, or Texas. He observes that the prospective oil and gas area in Canada includes some 891,000 square miles, of which 250,000 square miles are in Alberta.

What Condemns Profits. "Earning statements of big industry make inviting targets for those who would first discredit profits and then destroy them," stated Harry J. Kennedy, vice president of Continental Oil Company, Ponca City, Oklahoma, in an address at the annual meeting of the Iowa Independent Oil Jobbers Association. "This is the standard collectivist technique for killing off new venture capital and private borowing. If conditions can be so developed that the Reconstruction Finance Corporation must do all industry financing—and if it can all be distress financing because of business losses instead of profits—government will have taken over. To the enemies of the profit system of incentive in business, every profit is too big. A rule that makes certain profits evil because the leftists can't take a slice of them, or because they are bigger than some one else's, plainly condemns all profits."

In other words, don't judge profits by the company it doesn't keep.

Earnings 67 Per Cent Above 1947 are reported for 1948 earnings by the nation's leading oil companies, according to the Wall Street Journal. "Profits were bolstered by increased sales of oil products and a higher price level during the year," stated the Journal. "The outlook for oil company earnings for 1949 is uncertain because of the change in the position of the industry." The supply of oil has caught up with demand. . . . Production of oil and refinery

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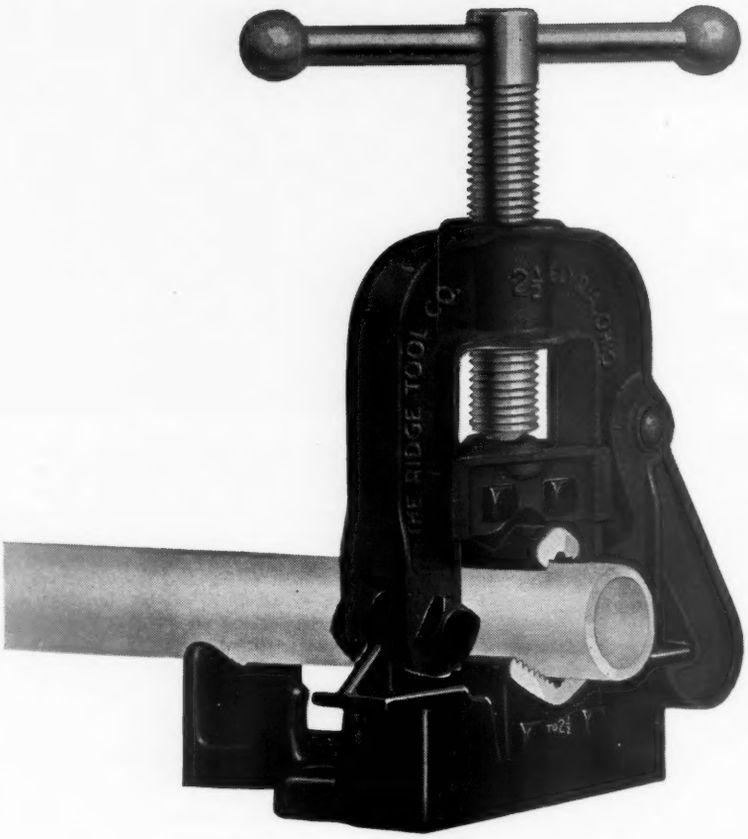

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runs in the past few months has been substantially reduced. Prices of heavy fuel oil and light fuel oil have been lowered. In some areas gasoline prices have also been reduced. The problem of the industry, so far in 1949, has been to cut the oil production back to meet a slower rate of increase in demand. Inventories of oil products have swollen and are in need of paring, according to most oil observers.

"The following table gives the estimated common share earnings of a number of oil companies for 1948, together with actual earnings reported for 1947. In many cases the number of shares outstanding have been increased. The tabulation assumes no extraordinary year-end adjustments or any special provision for amortization of fixed assets."

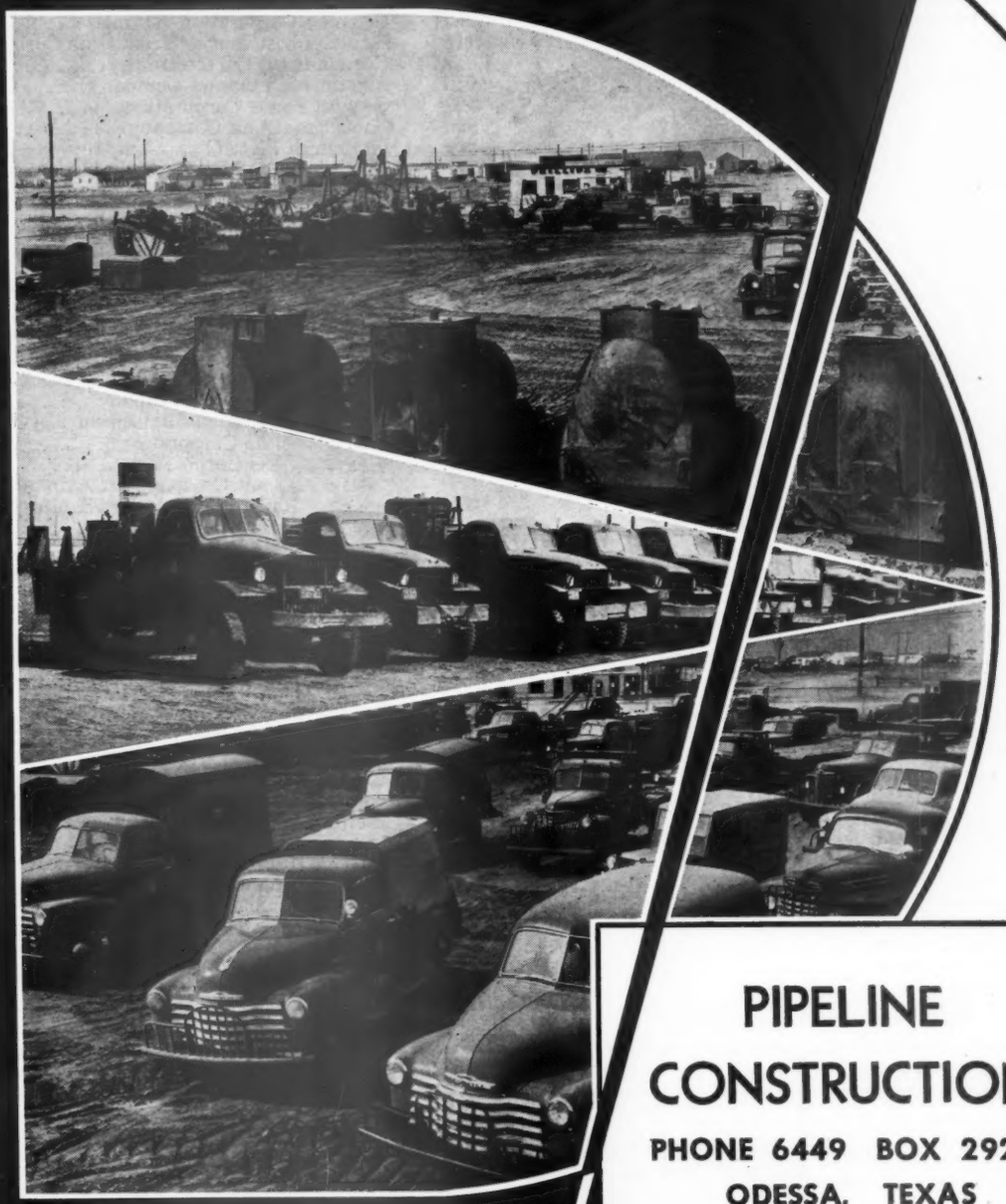
	1948	1947
Amerada Petroleum	$14.25	$9.46
Atlantic Refining	*12.60	5.32
Barnsdall Oil	6.05	4.10
Continental Oil	11.25	6.61
Gulf Oil	13.30	10.53
Houston Oil	5.50	3.67
Lion Oil	10.00	6.83
Louisiana Land & Exploration	2.45	1.54
Mid-Continent Petroleum	13.00	9.49
Ohio Oil	7.50	4.44
Phillips Petroleum	12.00	8.11
Plymouth Oil	*6.38	4.01
Pure Oil	9.50	4.77
Richfield Oil	4.20	2.96
Seaboard Oil	5.60	4.83
Shell Union Oil	8.10	4.44
Sinclair Oil	7.00	4.07
Socony-Vacuum Oil	4.10	3.13
Standard Oil of California	11.75	8.25
Standard Oil (N. J.)	13.00	9.83
Standard Oil (Ohio)	6.50	4.41
Tide Water Associated	6.10	4.57
Sun Oil	*8.61	5.28
The Texas Co.	12.00	7.90
Union Oil of California	6.30	3.85

*Official report of the company.

▸ **An Odd Court Case** was the $6,000,000 suit of James Moffitt against the Arabian-American Oil Company for alleged services in protecting the company's oil concessions in Saudi, Arabia. Last month Federal Court Jury in New York awarded the former Arabian-American executive $1,150,000 for services in influencing public authorities on behalf of Arabian-America. Moffitt contended in his suit that he talked to President Franklin Roosevelt and other government officials for the company. A defense motion to set aside the verdict contended "no man can make a contract to sell his influence with public authorities."

▸ **Moslem Business Leaders** are planning a meeting for June with the objective of taking over British and American Oil interests in the Middle East, according to a report from Pakistan. A working capital of several million pounds sterling is said to be back of the move.

DEATON AND SONS



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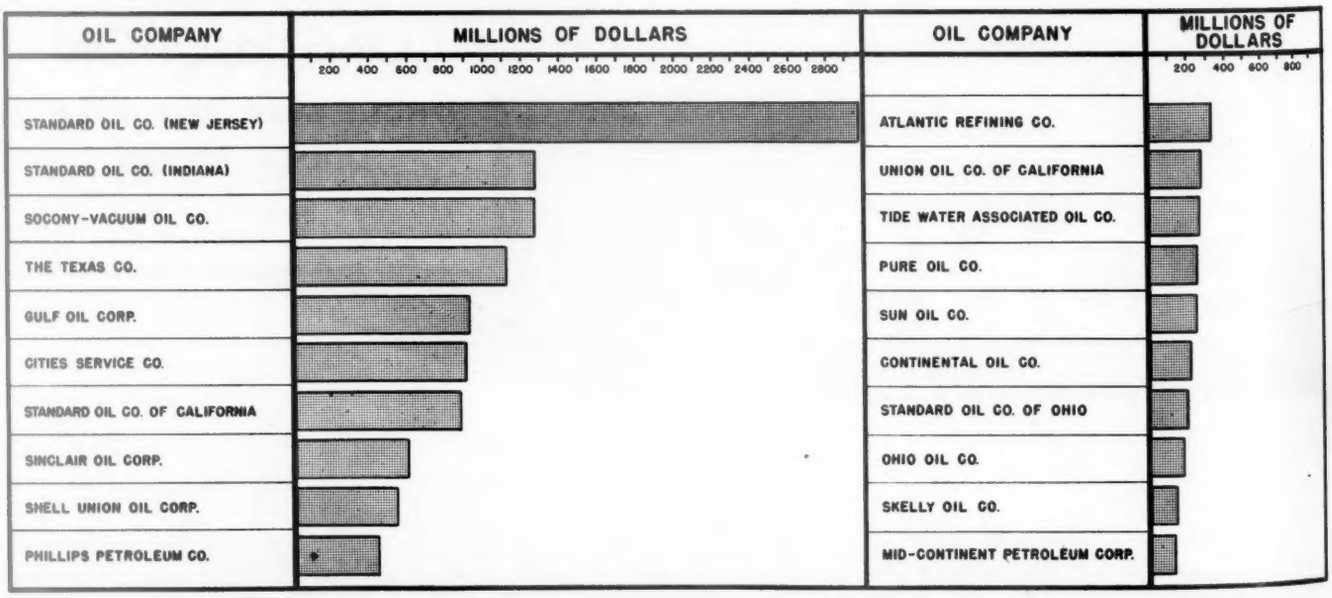
ASSETS OF 100 LARGE U. S. CORPORATIONS

(December 31, 1947)

	Total assets (million dollars)
Standard Oil Company (New Jersey)	**$ 2,996**
General Motors Corporation	2,473
U. S. Steel Corporation	2,163
E. I. DuPont de Nemours & Company	1,438
Standard Oil Company (Indiana)	**1,268**
Socony-Vacuum Oil Company	**1,262**
Texas Company, The	**1,115**
General Electric Company	1,027
Bethlehem Steel Corporation	949
Gulf Oil Corporation	**929**
Cities Service Company	**900**
Standard Oil Company of California	**876**
Western Electric Company	771
Union Carbide & Carbon Corporation	649
American Tobacco Company	647
Anaconda Copper Mining Company	637
International Harvester Company	620
Westinghouse Electric Corporation	602
Sinclair Oil Corporation	**591**
Allied Chemical & Dye Corporation	575
Kennecott Copper Corporation	541
Shell Union Oil Corporation	**534**
Chrysler Corporation	487
R. J. Reynolds Tobacco Company	458
Republic Steel Corporation	455
Phillips Petroleum Company	**439**
Swift & Company	437
Aluminum Corporation of America	430
Armour & Company	421
United Fruit Company	419
Goodyear Tire & Rubber Company	408
Liggett & Myers Tobacco Company	366
Eastman Kodak Company	360
U. S. Rubber Company	348
Jones & Laughlin Steel Corporation	341
Atlantic Refining Company	**330**
Firestone Tire & Rubber Company	324
Schenley Distillers Corporation	318
National Steel Corporation	292
International Paper Company	279
National Dairy Products Company	277
Union Oil Company of California	**272**
Distillers Corporation (Seagrams)	267
Tide Water Associated Oil Company	**263**
Youngstown Sheet & Tube Company	260
Ameircan Smelting & Refining Company	256
Phelps Dodge Corporation	251
American Can Company	250
Irmco Steel Corporation	249
A. F. Goodrich Company	247
Bure Oil Company	**245**
Pnland Steel Company	244
Procter & Gamble Company	242
Sun Oil Company	**242**
Deere & Company	229
Borden Company	222
Radio Corporation of America	216
Celanese Corporation of America	212
National Distributing Production Corporation	210
Continental Oil Company	**209**
American Cyanamid Company	207
General Foods Corporation	207
Continental Can Company	207
Pittsburgh Plate Glass Company	207
Allis Chalmers Manufacturing Company	202
American Viscose Corporation	201
Monsanto Chemical Company	199
Pullman, Incorporated	197
Weyerhauser Timber Company	195
Coco Cola Company	192
Standard Oil Company of Ohio	**189**
International Business Machine Corporation	184
Curtiss-Wright Corporation	166
Ohio Oil Company	**164**
National Lead Company	163
Owens-Illinois Glass Company	162
Hearst Consolidated Publications	161
United Aircraft Corporation	160
Wheeling Steel Corporation	158
National Biscuit Company	154
American Radiator & Standard Sanitary Corporation	153
Borg-Warner Corporation	151
Corn Products Refining Company	146
Wilson & Company	140
Nash-Kelvinator Corporation	138
Standard Brands, Incorporated	135
Walker-Goodernam & Worts	134
Stregis Paper Company	133
American Sugar Refiining Company	133
General American Transportation Corporation	132
U. S. Gypsum Company	132
Skelly Oil Company	**129**
Crane Company	129
Burlington Mills Corporation	125
Bendix Aviation Corporation	123
Caterpillar Tractor Company	122
American Woolen Company	118
Mid-Continent Petroleum Corporation	**116**
Johns Manville Corporation	115
Reynolds Metals Company	112
Total 100 companies	$41,629
Total 20 oil companies	$13,069
Per cent of total	31.4

Source: Published Financial Reports.



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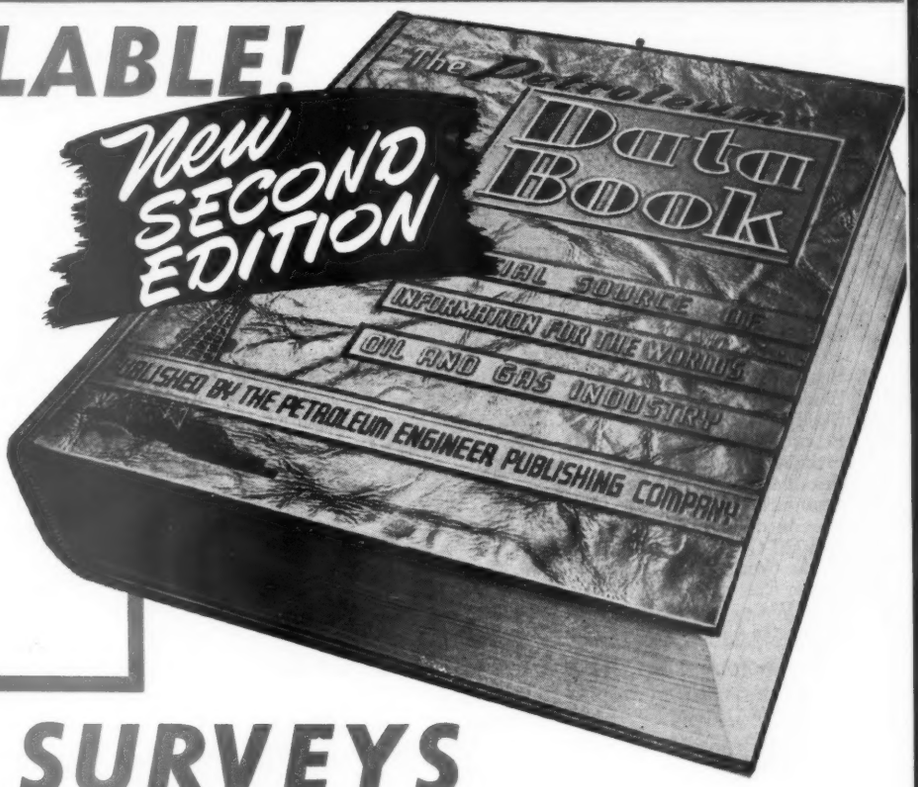
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DOMESTIC PRODUCING OIL WELLS

(End of year)

	1942	1943	1944	1945	1946	1947	Position
Amerada Petroleum Corporation	1,517	1,558	1,663	1,744	1,813	1,981	20
American Republic Corporation	252	240	232	235	242	257	26
Argo Oil Corporation	84	91	102	107	111	116	28
Arkansas Fuel Oil Company*	1,330	1,298	1,286	1,254	1,231	1,251	*
Atlantic Refining Company, The	2,421	2,769	2,852	2,862	2,731	2,766	16
Barnsdall Oil Company	2,030	2,932	1,942	1,955	1,899	1,930	21
Bishop Oil Company	227	265	n.r.	268	272	287	25
British American Oil Co., Ltd.	n.r.	n.r.	n.r.	n.r.	397	430	23
Cities Service Company	5,969	5,803	5,688	5,453	7,679	8,270	6
Continental Oil Company	5,764	6,112	6,169	3,748	3,797	4,276	13
Derby Oil Company, The△	164	167	206	219	233	238	27
Gulf Oil Corporation	9,009	8,929	9,221	9,440	9,545	10,744	3
Humble Oil & Refining Company†	7,856	7,913	8,030	8,353	8,695	8,946	†
Lion Oil Company	284	314	334	376	394	429	24
Mid-Continent Petroleum Corporation	1,067	1,067	1,055	1,561	1,656	1,755	22
Ohio Oil Company, The	10,322	9,665	8,824	7,892	7,760	7,687	8
Pan American Petroleum & Transport Co‡	147	149	168	185	290	377	‡
Panhandle Producing & Refining Co.	n.r.	n.r.	n.r.	n.r.	303	n.r.	—
Phillips Petroleum Company	5,936	6,577	6,780	n.r.	n.r.	n.r.	—
Pure Oil Company, The	5,698	5,770	5,981	6,030	6,119	6,088	10
Quaker State Oil Refining Corp.	n.r.	n.r.	3,500	3,537	3,529	3,549	15
Richfield Oil Corporation⊕	525	533	594	n.r.	n.r.	n.r.	⊕
Shell Union Oil Company	8,255	8,412	8,619	8,822	8,870	9,216	5
Sinclair Oil Corporation	8,181	7,916	7,930	7,929	7,231	6,971	9
Skelly Oil Company	2,389	2,490	2,781	2,963	2,473	2,601	17
Socony-Vacuum Oil Co., Inc.	9,772	9,819	10,024	10,120	10,034	10,486	4
Standard Oil Company of California	4,220	3,992	4,204	4,562	4,894	5,332	11
Standard Oil Company (Indiana)	5,635	6,114	6,538	6,813	7,205	7,772	7
Standard Oil Company (New Jersey)	11,573	10,690	11,103	11,133	11,750	12,140	2
Standard Oil Company (Ohio)	313	548	1,043	1,357	1,595	2,058	19
Sun Oil Company	2,602	2,709	2,898	3,068	3,364	3,630	14
Texas Company, The	11,266	11,806	12,550	12,308	12,690	12,956	1
Texas Pacific Coal and Oil Co.	918	905	n.r.	n.r.	n.r.	n.r.	—
Tide Water Associated Oil Company	5,017	5,128	5,181	5,195	5,726	5,200	12
Union Oil Company of California	1,425	1,466	1,776	1,899	1,944	2,181	18

ACREAGE HELD IN LEASE AND FEE—UNITED STATES (NET)

(End of year)

	1942	1943	1944	1945	1946	1947	Position
Amerada Petroleum Corporation	983,000	1,262,000	1,432,000	1,457,000	1,309,000	1,724,000	18
American Republics Corporation	1,368,479	1,405,054	1,558,935	1,674,887	1,678,325	1,684,956	19
Argo Oil Corporation	94,824	125,246	174,116	171,329	169,331	183,852	29
Arkansas Fuel Oil Company*	443,844	476,489	756,978	851,019	720,772	582,612	*
Atlantic Refining Company, The	1,530,000	2,252,600	3,665,000	4,549,000	3,913,500	3,820,600	10
Barnsdall Oil Company	762,414	571,205	810,780	767,295	724,114	731,410	25
Bishop Oil Company	n.r.	12,608	11,525	14,496	15,971	19,426	33
Cities Service Company	2,332,000	2,728,000	3,264,000	3,557,000	3,470,000	3,598,000	11
Continental Oil Company	1,424,787	1,670,919	1,986,827	1,949,776	1,858,222	2,009,441	17
Derby Oil Company, The	79,470	85,229	85,129	75,836	56,369	62,646	32
Gulf Oil Corporation	5,992,788	7,440,881	8,251,368	11,251,920	11,200,886	11,023,385	2
Houston Oil Company of Texas, and Houston Pipe Line Company	n.r.	n.r.	n.r.	n.r.	n.r.	843,000	24
Humble Oil & Refining Company†	⊛11,000,000	11,518,883	16,387,239	17,291,448	17,785,136	18,272,710	†
Lion Oil Company	272,880	392,475	734,654	688,995	587,298	591,876	27
Louisiana Land & Exploration Co., The	n.r.	n.r.	n.r.	n.r.	884,179	926,329	23
Mid-Continent Petroleum Corporation	745,556	780,919	775,587	818,961	890,767	957,674	22
Ohio Oil Company, The	1,602,993	1,353,319	2,491,378	2,333,506	2,474,805	2,262,798	15
Pan American Petroleum & Transport Co.‡	134,809	143,536	168,032	202,968	282,652	393,413	‡
Phillips Petroleum Company	2,436,921	3,512,100	4,767,683	4,466,758	4,344,602	4,435,303	8
Plymouth Oil Company	n.r.	n.r.	n.r.	n.r.	n.r.	349,129	28
Pure Oil Company, The	2,298,562	2,506,226	2,984,871	3,086,414	2,809,287	2,283,886	14
Richfield Oil Corporation⊕	n.r.	n.r.	n.r.	172,995	133,193	197,934	⊕
Shell Union Oil Company	1,454,581	1,559,516	3,172,228	3,713,469	3,709,855	3,099,855	12
Sinclair Oil Corporation	4,018,434	4,657,749	5,781,348	5,315,128	5,384,256	5,945,953	7
Skelly Oil Company	n.r.	n.r.	n.r.	1,893,247	1,955,161	2,124,394	16
Socony-Vacuum Oil Co., Inc.	8,278,511	8,861,778	10,057,152	11,026,143	10,355,536	10,158,973	3
Standard Oil Company of California	1,353,323	2,567,244	2,979,666	3,068,584	3,360,517	4,091,019	9
Standard Oil Company (Indiana)	5,688,911	6,232,366	9,131,945	8,487,163	7,461,119	8,191,701	5
Standard Oil Company (New Jersey)	13,269,800	15,048,700	19,726,700	21,079,000	23,018,900	21,487,900	1
Standatd Oil Company (Ohio)	444,958	1,212,501	1,391,361	1,361,881	1,101,400	1,250,384	21
Sun Oil Company	4,657,319	5,303,904	6,860,121	7,662,136	7,803,900	7,973,945	6
Sunray Oil Corporation	n.r.	n.r.	n.r.	n.r.	n.r.	76,686	31
Texas Company, The	8,670,848	9,539,599	10,490,347	10,056,785	9,561,802	9,815,949	4
Texas Pacific Coal and Oil Co.	341,769	371,043	506,376	486,557	489,138	610,030	26
Tide Water Associated Oil Company	985,071	1,114,398	2,005,939	2,111,674	2,275,090	2,548,652	13
Union Oil Company of California	431,207	503,750	669,691	856,335	991,839	1,270,045	20
Wilcox Oil Company	n.r.	n.r.	n.r.	n.r.	n.r.	83,222	30

*Included with Cities Service Company.
†Included with Standard Oil Company (New Jersey).
‡Included with Standard Oil Company (Indiana).
⊕Included with Sinclair Oil Corporation.
△Includes gas wells.
n.r.–Not reported.
⊛Estimated.

Source: Survey of *The Petroleum Data Book* and company financial reports.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

THE Petroleum Engineer

MARCH
1949

MODERN ART TANK BLEEDING

RICHARD SNEDDON*

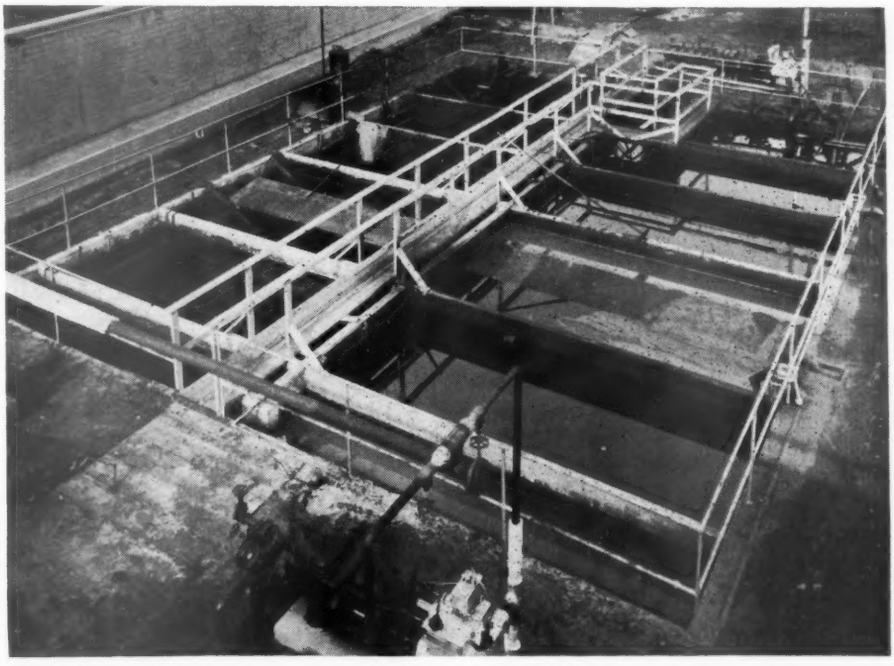
EXCLUSIVE

DESPITE the fact that crude oil and formation water are markedly different in most of their physical properties, the complete and continuous separation of the two has always been a major problem in oil field operation. The main reason for this is that under frequently occurring circumstances, oil and water readily emulsify, not necessarily in a simple, single proportional relationship, but on the contrary, usually in a long series of proportions. This at once nullifies or at least reduces the separatory tendency of the original gravity differential between the components, and more or less complicates the other physical relationships and effects. Thus, total emulsification of oil and water is rare, and the most common condition is that in which there are at least three phases—oil, water, and emulsion. Even though there may be total emulsification at some stage in the production process, the relative instability of emulsions is certain in the majority of cases to result comparatively soon in some loosening of the combination and some resolution into the original components, so producing a multi-phase mixture.

*Pacific Coast Editor.

There are well recognized methods of breaking down oil-water emulsions, utilizing heat, electricity, steam, and chemical reagents, individually and in various combinations. This discussion, however, is not concerned with so-called dehydration but with the simple process known as tank bleeding. It would seem offhand that such an elementary practice is hardly worthy of detailed discussion, but examination will soon show that although fundamentally simple it can be grossly inefficient as well as costly if it becomes a casual procedure, and, conversely, can, if carefully carried on, bring dividends in convenience that are distinctly worthwhile, and also save real time and money. The desirability of removing free water from production oil at the earliest possible moment is obvious. Removing it at the source whenever possible eliminates subsequent dehydrating and pipe line pumping costs, facilitates handling in many ways, and may substantially reduce equipment corrosion and other deleterious effects that result from salt water.

The oldest of all systems of oil bleeding is the manual method that has been in operation since the birth



If modern automatic bleeding methods prove themselves, the old skimming ponds like this one will go.

of the petroleum industry and needs no definition here. It consists of the manual cracking of a valve, with periodic adjustment to keep clear water running off through the bleed line without simultaneously carrying off oil or emulsion, and it is continued with close observation until all free water has been removed. This system is effective only when the quantity of free water in the container is small enough to permit its removal in a short time and when the operator gives the process all his attention.

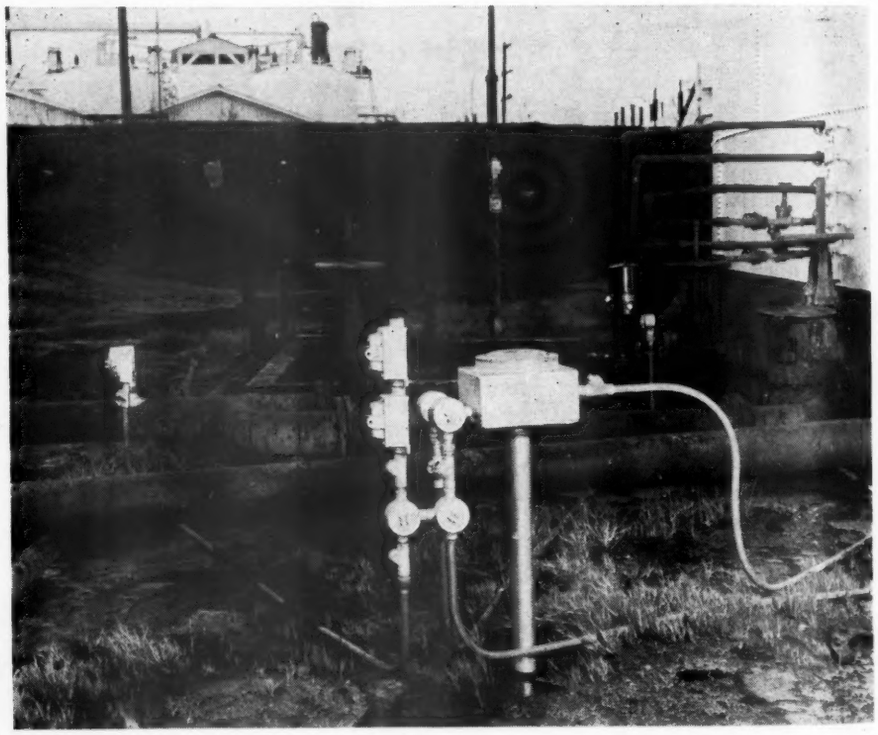
When the quantity of water is considerable and bleeding becomes a protracted procedure the human element enters into the picture much more forcibly and results are much less satisfactory. The most meticulous individual in the world is going to get bored eventually staring at that water stream, and the very perversity of chance is a guarantee that the oil will start flowing while he is looking in another direction. Even if he is conscientiously looking at the stream, the appearance of either emulsion or oil is his cue to close the valve, so that no matter how careful he may be there must be some discharge of oil.

It is also to be noted that the stratification of oil-water emulsion, oil, and water does not take place in accurately horizontal planes so that even if a gauge glass or other method of visualizing the emulsion-water interface at one point in the tank is employed and the rate of water bleeding be predetermined, it is still quite possible that the pumper may return to the tank at his calculated time only to find oil running copiously from the bleed line while water still shows at the gauge glass.

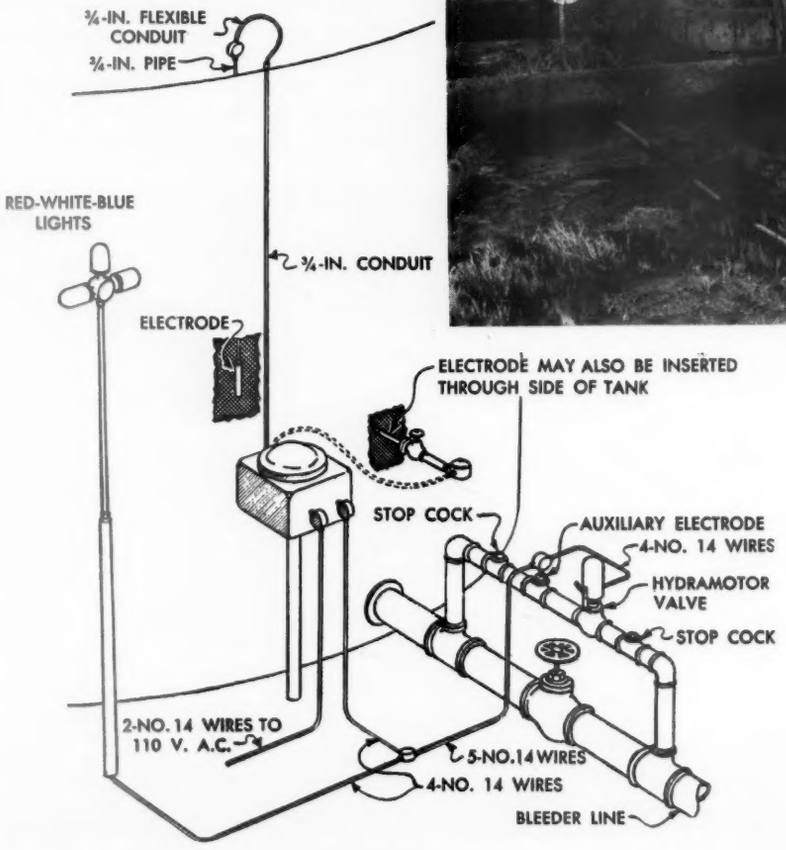
There is simply no way to predict with certainty the absolute level of the oil- or emulsion-water interface inside a tank. The rate of demulsification also is affected by temperature changes and other pertinent factors, and the top of the water line is coincidentally affected. This means that to assure a careful and complete manual bleeding job the operator must devote his attention to it from begining to end. That is costly and even with his best effort, if the water level is high and he starts with a heavy stream, coning is almost certain to begin somewhere along the line and oil in consequence will be sucked into the bleeder line.

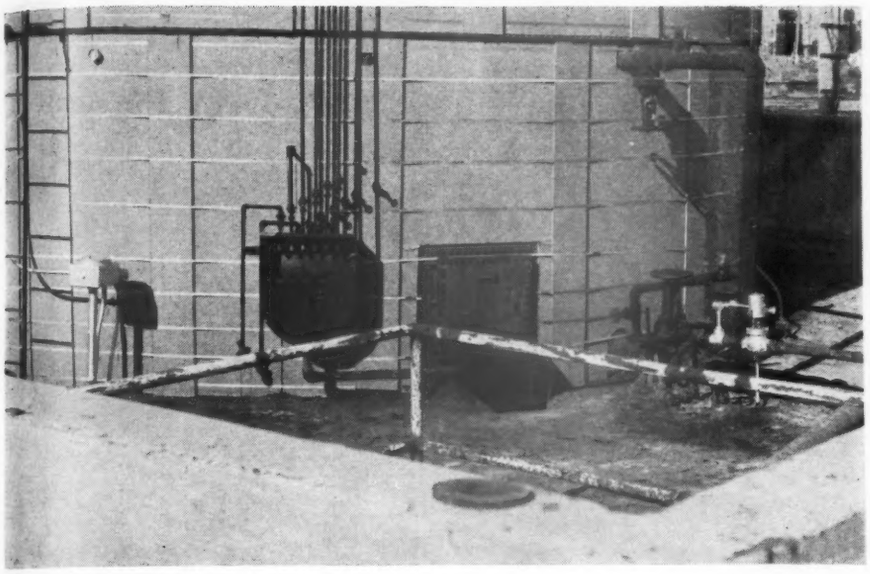
A well known approach to automatic bleeding is the water leg. This is in effect a siphon set in such a manner as to draw water continuously from the bottom area of the tank and maintain a constant oil level at the top. The top and bottom joints of the siphon are goosenecks so that the entire device may be raised or lowered as the occasion demands. Unfortunately, the efficacy of this device is limited by the fact that in many instances demulsification does not take place at a constant rate. It is therefore quite possible for the water level to drop down below the bottom end of the siphon and for emulsion or oil to be bled off instead of water. The primary function of the water leg is to accomplish the removal of water automatically, but all too often the condition described prohibits its use.

It is, of course, also essential that care be taken to set the top bend of the siphon and the open end inside the tank at just the right elevations. Then when these have been decided upon it is further necessary to maintain the positions selected with some rigidity to avoid undue loss of oil. What we mean here is that if connections are not sufficiently tight and the

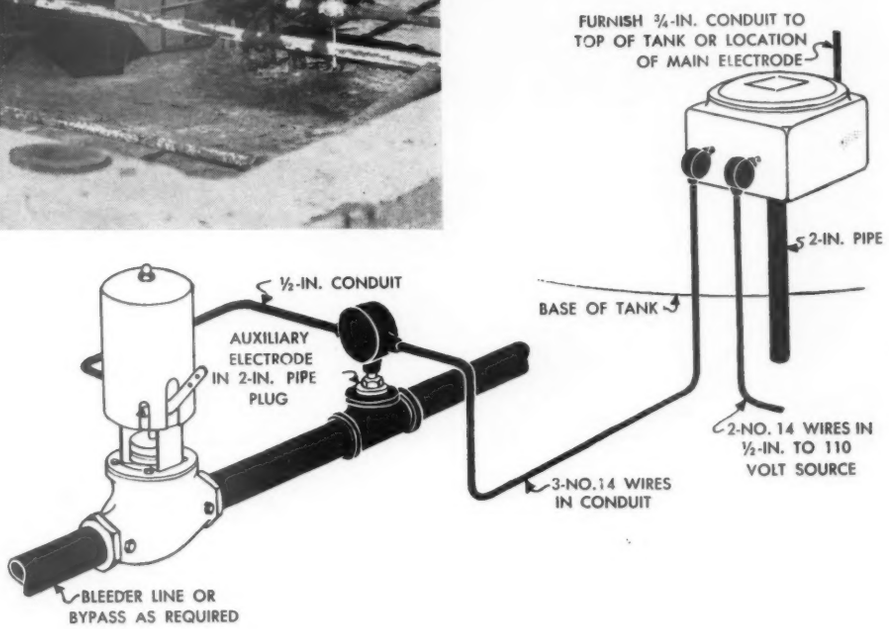


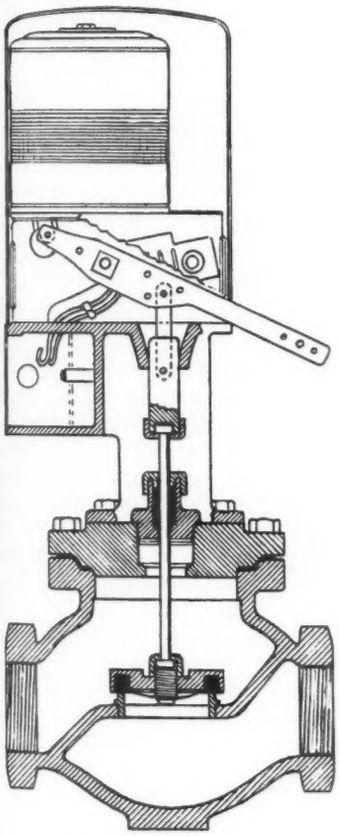
An installation of an auto-electronic tank bleeder with lights and a diagram of same. This device can be set to trip for any condition *at the location of the electrode*, so that emulsion need never get near the bleed line.





This is an auto-electronic bleeder installation without lights, and diagram. Recent experiments have shown that water level can be automatically controlled by this system even under the most involved conditions. It is applicable to production, storage, refinery tankage, or wherever fluctuating oil and water levels present a problem.


FURNISH ¾-IN. CONDUIT TO TOP OF TANK OR LOCATION OF MAIN ELECTRODE
2-IN. PIPE
BASE OF TANK
½-IN. CONDUIT
AUXILIARY ELECTRODE IN 2-IN. PIPE PLUG
2-NO. 14 WIRES IN ½-IN. TO 110 VOLT SOURCE
3-NO.14 WIRES IN CONDUIT
BLEEDER LINE OR BYPASS AS REQUIRED



General controls.

HYDRAMOTOR VALVES

1# DROP ACROSS VALVE

Valve Size	Bbl/Hr
1½"	40
2"	65.5
3"	114
4"	220
5"	353
6"	500

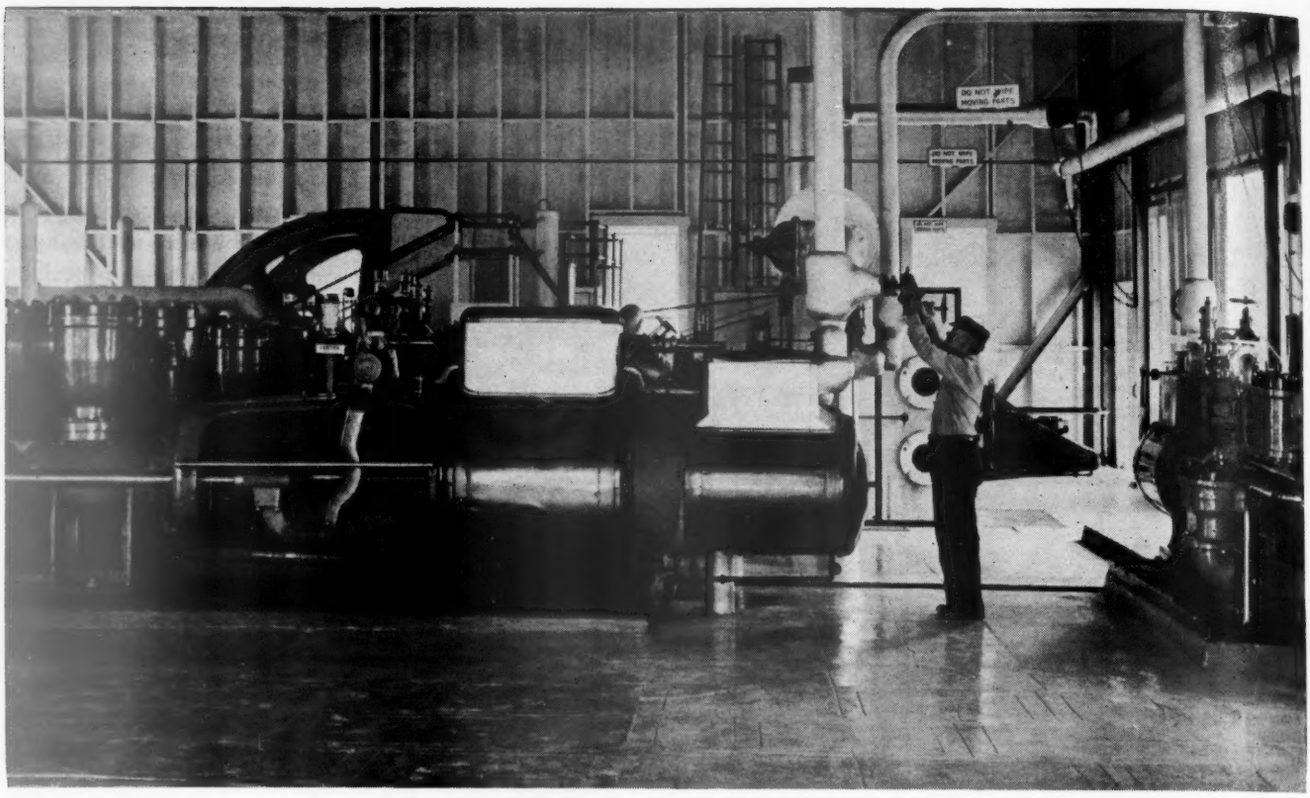
entire apparatus becomes too flexible, a stiff wind or a shock of some sort may swing the suction end of the siphon out of water into oil with rather unpleasant results.

It is not the purpose of this discussion to discredit the foregoing systems of tank bleeding. They have their place in field operation but it must also be recognized that they have their limitations. For the stripper well operator who can give close attention to bleeding operations or, where the quantity of free water is small and may be quickly removed, the manual system is adequate. By the same token when the water content of a receiving tank is excessively high, the water leg can be of real service in removing the bulk of it and rendering subsequent complete removal more easy and less costly. The same is true of automatic bleeding devices based on gravity differential between the oil or emulsion and water. In order to get clean-cut manipulation of the valve on the bleeder line there must be a comparatively high gravity differential between the two involved components. When that condition maintains, the gravity operated system is effective. Viscosity controlled bleeders similarly have been used to good advantage but like manual operations they do not shut off until oil or emulsion is actually in the bleed line.

There are extraneous influences that affect many of the automatic devices regardless of the fundamental means of actuation. Corrosion, for example, can interfere with the free action of linkages or motivating parts where it can develop. In electric systems based on conductivity differentials electrodes must be kept out of oil to assure satisfactory performance. The viscosity differential system may develop a plugging action because of abnormal changes in surface tension. Again, however, it should be emphasized that there is no such thing as perfection in any measurement or device, and the several species of automatic bleeders already referred to mark a great advance over indiscriminately used manual bleeding. It would seem to be necessary in each instance to determine all the facts and then apply that particular system that seems to best fit the need.

A device that controls the tank bleeding operation by a distinctly novel process is now finding wide application in field service.* This particular system depends for its opera-

*Ennis Auto-Electronic Tank Bleeder.



Apart from the inconvenience and discomfort of water troubles, it is economically unsound to be pumping through transportation systems water that might easily be disposed of in the field. Photo shows pump house of Stanpac line, Kettleman.

tion on its sensitivity to low voltage high frequency electrical fields, and employs the signal so derived to manipulate an electrically driven hydro-motor valve. The unit consists of a very sensitive electrode, set in the tank at the proper point to detect the arrival of water at the critical bleeding level. The presence of the water unbalances a low voltage electrical field and the disturbance actuates a hydro-motor valve on the bleed line, holding it open until the proper water level is reestablished. An interesting bit of auxiliary equipment utilized for safety purposes is a shut-off electrode that closes the valve at the first indication of oil in the bleed line.

The electrostatic field that is formed around the electrode in the tank is large enough in area that it is not necessary for water to make actual contact with the electrode in order to open the valve. Its presence in the field is sufficient. Also, the coating of the electrode with oil in no way influences the bleeding cycle, although sensitivity is acute enough to detect the entry of emulsion into the field. The bleeding differential can be set so that pure water must enter the field to actuate the valve, and the first indication of emulsion in the same area will close it.

Changes in the gravity of the oil have a negligible effect on the control cycle, and operation is not disturbed by normal changes in line voltage. Thus, continued functioning is assured without the necessity of constant attention. The installation is completely free from fire hazard and is so designed that when power fails the bleed valve automatically closes.

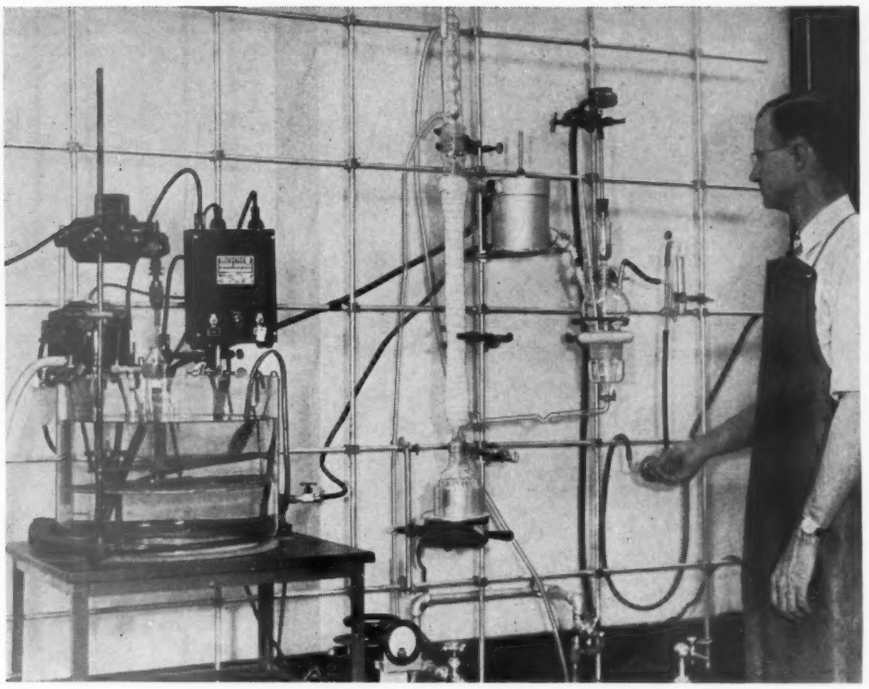
Refineries, too, since the very inception of petroleum distillation have been plagued by water in the various stages of segregation and treatment. "Puking" is a very descriptive word that is used to indicate the spill-over that results from super-heating of water in a still containing wet oil. The phenomenon is at once messy, destructive, and dangerous. The necessity, then, of controlling water levels in refinery feed and rundown tanks becomes rather obvious. Some recent experiments have yielded excellent results in water level control in refinery rundown tanks, with the use of an auto-electronic bleeder. These particular tanks are on a constant stream with an input cut that varies from zero to 10 per cent plus. The quantity of emulsion and the fluid gravity also vary widely, in consequence of which the water level fluctuates as much as 25 per cent.

This obviates the possibility of employing a water leg or other bleeding device that requires for its success a uniform head. It also eliminates systems that operate on the basis of surface tension or gravity differential; however, as stated, the auto-electronic bleeder has handled this situation without a hitch. Indeed, it appears to be admirably adapted for use in any department—production, pipe line, or refining—in which the conditions that have been described prevail.

It may be pointed out in conclusion that in this scientific age methods subject to human error, including methods for bleeding water from oil tanks, are slowly being discarded in favor of more precise, more accurate, and more consistent automatic devices. There are always local circumstances that must determine the ultimate choice of system in each individual instance and there will continue to be employment of the older methods of tank bleeding where the prevailing economics so dictate. It can be pretty truthfully said that we are first faced with the problem and then we find the remedy. From which it may be deduced that the evolution of tank bleeding practice from manual performance to the most modern automatic device has merely been a part of the general scientific advance in all phases of the industry. There can be no question that where conditions warrant their use, approved automatic systems are efficient, economical, and in general to be preferred. * * *

EXCLUSIVE

PART 4. The Division's part in development of oil resources rates high with the industry — its usefulness in the future can be valuable to coordination of public and private enterprise.



The Laramie station analyzes asphalts†

History and Analysis of Bureau of Mines' PETROLEUM AND NATURAL GAS DIVISION

ERNESTINE ADAMS*

In the brief outline of the 35-year history of the Petroleum and Natural Gas Division of the Bureau of Mines (Parts 2 and 3) an effort has been made to evaluate its work in the past. Now it is time to look at the Division's present activities and future prospects. It should be possible thus to estimate the modern value of the unit to the industry, the government, and the public.

In the past the Division has fulfilled an important mission in the study and promotion of conservation practices. What about now and the future?

The interest of the nation in reducing regular costs of the federal government to a more economic level is good reason for close scrutiny of all bureaus. A study of Fig. 1 (Part 1), which shows 73 separate federal agencies concerned with oil and gas operations (local government adds several more) reveals what one industry is faced with in its ordinary business activities. Certainly an effort must be made toward retrenchment and consolidation if free enterprise is going to remain either free or enterprising. The question we shall try to answer is whether under these conditions the Petroleum and Natural Gas Division is an effective instrument in the complicated operations of modern industry and, if so, what policies it can follow to insure future usefulness.

In plain words: Is it worth the money?

So far the industry has agreed, almost without dissent, that the Division has played an important role in the fabulous development of U. S. oil and gas resources. It believes the Division did great work in furthering conservation and that it should continue its work along the same lines.

In expressing the opinion that the Division should carry on, the industry reveals a spotty conception of the position the unit occupies in the federal hierarchy and the extent of its functions.

Status in Bureau of Mines. Another examination of Fig. 1 (Part 1) gives an idea of the complex organization of the Bureau of Mines, which is concerned with petroleum and natural gas as one among many mineral resources.

Of the seven major units within the Bureau the following four have functions relating directly to petroleum and natural gas.‡

1. Fuels and Explosives Branch.
   (1) Petroleum and Natural Gas Division.
   (2) Fuels Utilization Division.
   (3) Office of Synthetic Liquid Fuels.
   (4) Explosives Division.
   (5) Coal Division.
2. Economics and Statistics Branch.
3. Health and Safety Branch.
4. Office of Minerals Reports.

The Petroleum and Natural Gas Division under the Fuel and Explosives Branch, subject of this series of articles, is the only agency that by direct mandate from Congress con-

*Managing Editor, *The Petroleum Engineer.*

†The apparatus shown is for solvent extraction in the analysis of asphalt, used especially for separation of asphalts into asphaltenes, resins, and oils.

‡Designations here are those in effect before 1948 change. Fig. 1 has present designations.

Engineers travel from field to field with mobile lab like this to analyze properties of fluids from gas-condensate wells. A flexible, high pressure tubing connects testing equipment to wellhead fittings

ducts research on production, transportation, and refining of oil and natural gas.

Some operators have the impression that the Petroleum and Natural Gas Division handles synthetic liquid fuel research, but that work is under the various divisions in the Office of Synthetic Liquid Fuels which was officially organized as of July 1, 1944. The two units may work together and sometimes do but long range policy for both is made on higher levels and may even be left to Congressional decision.

In Part 1 of this series the structure of the Petroleum and Natural Gas Division was described as composed of administrative offices in Washington, D. C., under R. A. Cattell as chief, with experimental stations in Bartlesville, Oklahoma, and Laramie, Wyoming; field offices at San Francisco, California; Dallas and Wichita Falls, Texas; and Franklin, Pennsylvania, and an operating helium plant at Excell, Texas, with helium plants in standby status at Amarillo, Texas; Otis, Kansas; and Shiprock, New Mexico. The technical staff now numbers about 136 men with 348 clerical, custodial, wage board,* and other employes.

Decentralized, to be near centers of activity, but necessarily well coordinated because of the small staff, the work of the group continues to be extensive within its limitations. Here is a list of the present projects of the various stations and their objectives†:

Secondary recovery—to gather history and methods of water flooding and air and gas injection. Franklin, Bartlesville, Dallas, Laramie, and San Francisco. Oil extraction from oil-impregnated deposits, San Francisco.

Reservoir studies—to provide solutions to oil recovery problems, based on laboratory and field studies. San Francisco, Franklin, Bartlesville, and Laramie.

Engineering field studies — to provide information on various types of reservoirs that will improve methods. Dallas, Franklin, and Bartlesville.

Phase relations of reservoir fluids —to determine pressure-volume-temperature relations of oil and gas as they occur in the formation. Bartlesville and Laramie.

Drilling fluid research — to study use of oil-base muds in drilling. San Francisco.

Helium — to increase supplies and extend uses of helium gas. Amarillo and Exell.

Natural gas—to study pipe line flow of gas and excess nitrogen removal from gas. Amarillo.

Black oil surveys—to promote the wider use of Rocky Mountain sulphur-base oils. Laramie.

Chemistry and refining—to analyze crude oils, to study the composition of diesel fuels, to determine and separate sulphur compounds in petroleum. Bartlesville and Laramie.

Thermodynamics — to determine the thermodynamic properties of petroleum hydrocarbons and related compounds. Bartlesville.

This refresher in the composition and projects of the Division is preliminary to a study of its accomplishments. We have grouped into the following nine numbered sections the effects of the Division's work that the industry has commented upon. To some degree each is an achievement as well as a purpose. If any dissatisfaction has been expressed about results or any suggestions made for improvements in the future, these are recorded and discussed.

1. Introduces and fosters improved methods in all petroleum and natural gas operations.

The Division works out and publicizes conservation measures to fit the problems constantly arising from the rapid development of oil and gas resources. The great contribution made under this category is willingly acknowledged by the industry. In the opinion of some operators, however, time is not properly allocated to suit the value of the various research projects. Some problems are given exhaustive study disproportionate to their importance. Others are dropped before a sound conclusion is reached or carried on at too slow a pace.

Exceptional judgment is necessary to assess the value of each project and to know exactly the extent to which it should be studied. If the Division errs it is usually in being too exhaustive. The problems that have been slighted by the Division, on the other hand, usually have been dropped because of limited personnel and/or appropriations. The stress of war work caused the suspension of some projects. Lack of funds, for instance, hindered secondary recovery research. (This has been overcome to some extent by recent appropriations.) This project has the virtual unanimous approval and interest of the industry and several have expressed regret that it was not progressing more rapidly. Requirements of technicians and money have prohibited an all-out effort, so far, on this attempt to extract the estimated 100 billion barrels of oil that are said to be available by secondary recovery.

2. Demonstrates to industry that research is an essential part of good business.

The Division was the principal agent in leading the industry of the early 20th century to the laboratory for aid. In modern times the need for research in general is accepted and the staff can devote its energies to making particular results convincing enough for industry to put them into practice.

In some quarters there is a feeling that the Division has worked itself out of a job in the promotion of research. In earlier days there was no other organization to take the lead in proving the benefits of applying scientific truths to petroleum operations. Compared with the tremendous growth of

*A large number of wage board employes are used in helium operations.

†Long range projects are stated in Appendix A, Page E-29.

research in private industry, the government research unit is today almost insignificant in size. A number of individual companies spend many times as much as the Division's appropriations on research.

So far as large companies are concerned the value of the Division is limited to some extent but small operators find the Division a reliable source of technical information as they do not have research departments of their own. Too many small operators do not know the assistance that is available from the unit but those who do have gained information valuable to the success of their operations.

The work of the Division on surveys and national correlated programs (so vital to pursuit of war) has also not been considered.

The expansion of private industry research has affected the program of the Division, putting stress on basic research and on industry-wide surveys in which many objectives may be difficult to reach by private work alone.

3. Provides industry with trained research personnel.

For several reasons, one being the small size of the staff, many young technicians who have had experience in the Division have left to enter private employment. Their training has proved valuable to their companies and many have become able leaders in industry. They seem to have taken with them a respect for scientific methods that has influenced their associates.

This has been a by-product rather than an objective of the Division but the number of comments made by executives shows that the movement has been noted and its importance appreciated.

4. Expands the value of tests and analyses by standardization.

This accomplishment includes such diverse benefits as the development of instruments for taking measurements and the long continuity of standardized analyses. The latter is possible for the Division because of its early recognition of the importance of standard processes in tests.

This is another phase of Division work that has received whole-hearted approval. An illustration is found in an incident that occurred in an East Texas field. Some engineers from the Division were working on instruments that could be used to measure pressures and temperatures in wells and to determine the solubility of natural gas in crude oils. An operating company aided the project substantially by constructing a field laboratory for the government engineers and by allowing the use of its wells and other facilities.

Then failure of sufficient appropriations, the bugaboo of the Division's planning, forced the director to drop the project.

The operators were interested and wanted to see the work carried on. Fourteen companies in the field got together and put up the money to complete the project. They made their wells available for study, though this interfered with regular operations; they put other facilities at the disposal of the Division, and, in addition, financed the completion of the project. The researchers came through with some answers that have benefited the whole industry.

5. Shortens the time lapse between successful experiment and practice.

The gap between theory and practice in the early days of the Division was wide and deep. Theories were not always put to the test of experiment, much less practice. For instance, unitization of a field for efficient operation was suggested by a Division man in 1915. It is only in recent times that the practice is being given a fair trial.

The time lapse has gradually shrunk because the Division has increased its efficiency in experimentation and the industry's respect for Division conclusions has grown.

Despite the development in confidence and mechanics that reduced the time between completion of a Bureau of Mines' research project and the industry's putting the results to use, the largest dissatisfaction with the Division's methods comes under this heading. Operators generally are of the opinion that there is unnecessary delay between the conclusion of a successful experiment and the distribution of the findings.

There are no insurmountable difficulties in speeding up distribution and it is a problem that should be worked out. Part of this time is devoured in checking and rechecking to satisfy the Division on thorough accuracy. To handle this a preliminary report could be made at once and the work gone over later before the permanent bulletin is published. The distribution process could be expedited by having a staff member, experienced in publication work, handle this phase of operation and be responsible for early distribution. The deliberative approach essential to accurate investigation is hard to combine with the speedy distribution of results that can rush improved methods into practice.

Charles B. Carpenter

The many valuable field engineering studies that Charles B. Carpenter has made since he joined the Bureau in 1928 leaves him well prepared to hold the post of supervising engineer at the Dallas, Texas, field office. He succeeded H. B. Hill in 1948.

An Oklahoman by birth, Carpenter went to the University of Colorado for his engineering degree, received in 1924. He spent four years on civil engineering projects in Oklahoma, Colorado, Wyoming, and Texas before he joined the Bureau to carry on production research.

6. Establishes a system of cooperative agreements.

One of the most promising aspects of the Division's program is the growth of cooperative research. These agreements are with government components, such as the agreement with Army-Navy on helium research; with industry associations, such as the agreement with the Natural Gas Department of the American Gas Association to investigate flow in high pressure gas lines; with local government, such as that with the State of Oklahoma on general improvement of conditions in the oil industry, and with schools, such as with Texas Technological College to experiment with well cuttings and core specimens.

Here is the account of one such cooperative agreement and how it worked:

Arkansas has a comparatively recent law on conservation, about which the Oil and Gas Commission felt it needed more information before it could be fairly administered. The Division was asked to study state fields and report the most efficient methods of producing in gas-drive and water-

GMV Turboflow Saves Fuel For Big And Little Big Inch

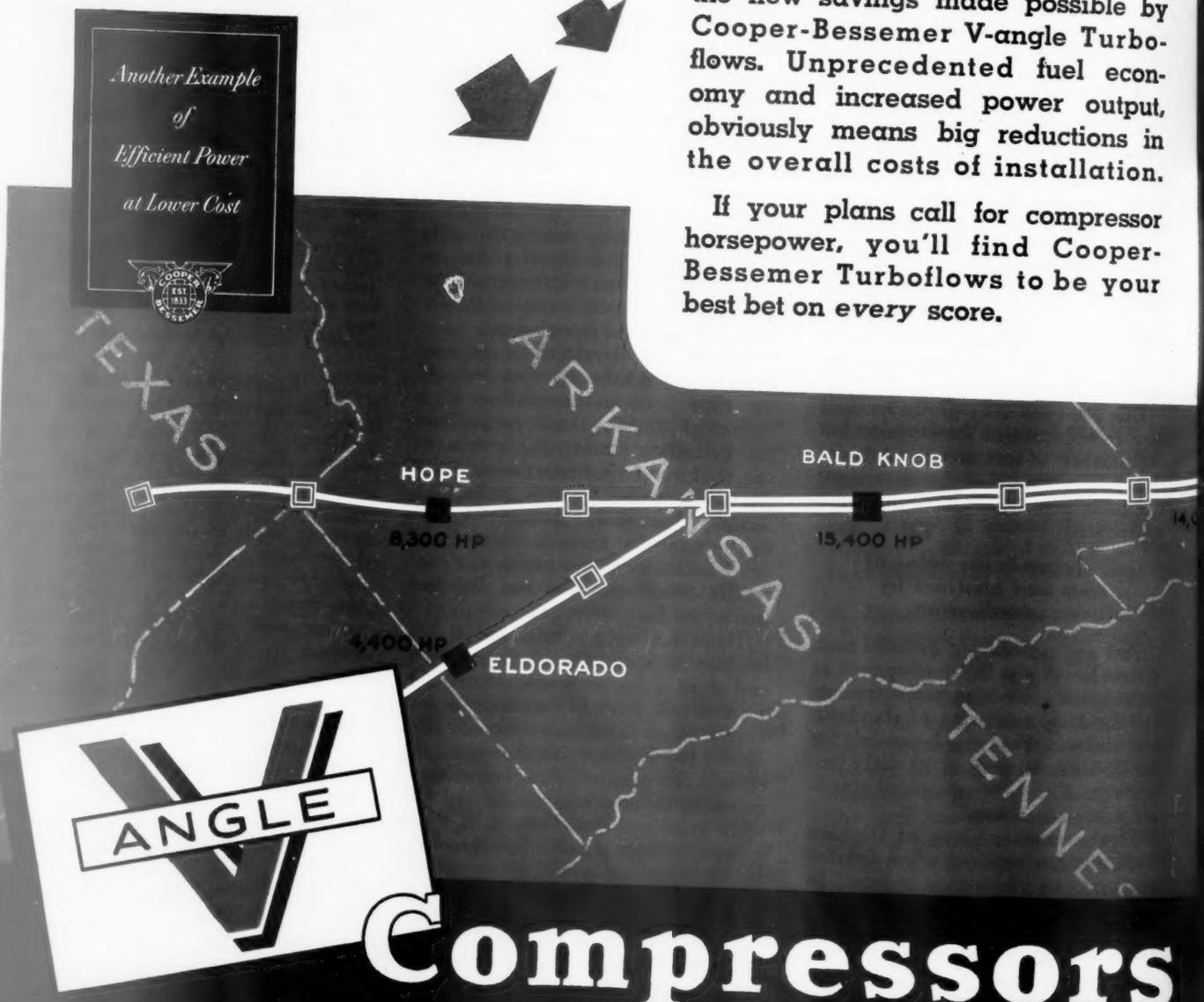
As indicated on this map of the Inch line, 5 of the 7 new stations powered by reciprocating engine-driven compressors are GMV-equipped — a total of 46,900 Cooper-Bessemer V-angle hp.

Of particular significance, the GMVs most recently furnished (29 of the 44 now on the lines) are *Turboflows* — Cooper-Bessemer's latest gas-engine development, affording a full 10% increase in power output while reducing fuel consumption by at least 15%.

Today, more and more of the big gas lines are taking advantage of the new savings made possible by Cooper-Bessemer V-angle Turboflows. Unprecedented fuel economy and increased power output, obviously means big reductions in the overall costs of installation.

If your plans call for compressor horsepower, you'll find Cooper-Bessemer Turboflows to be your best bet on *every* score.

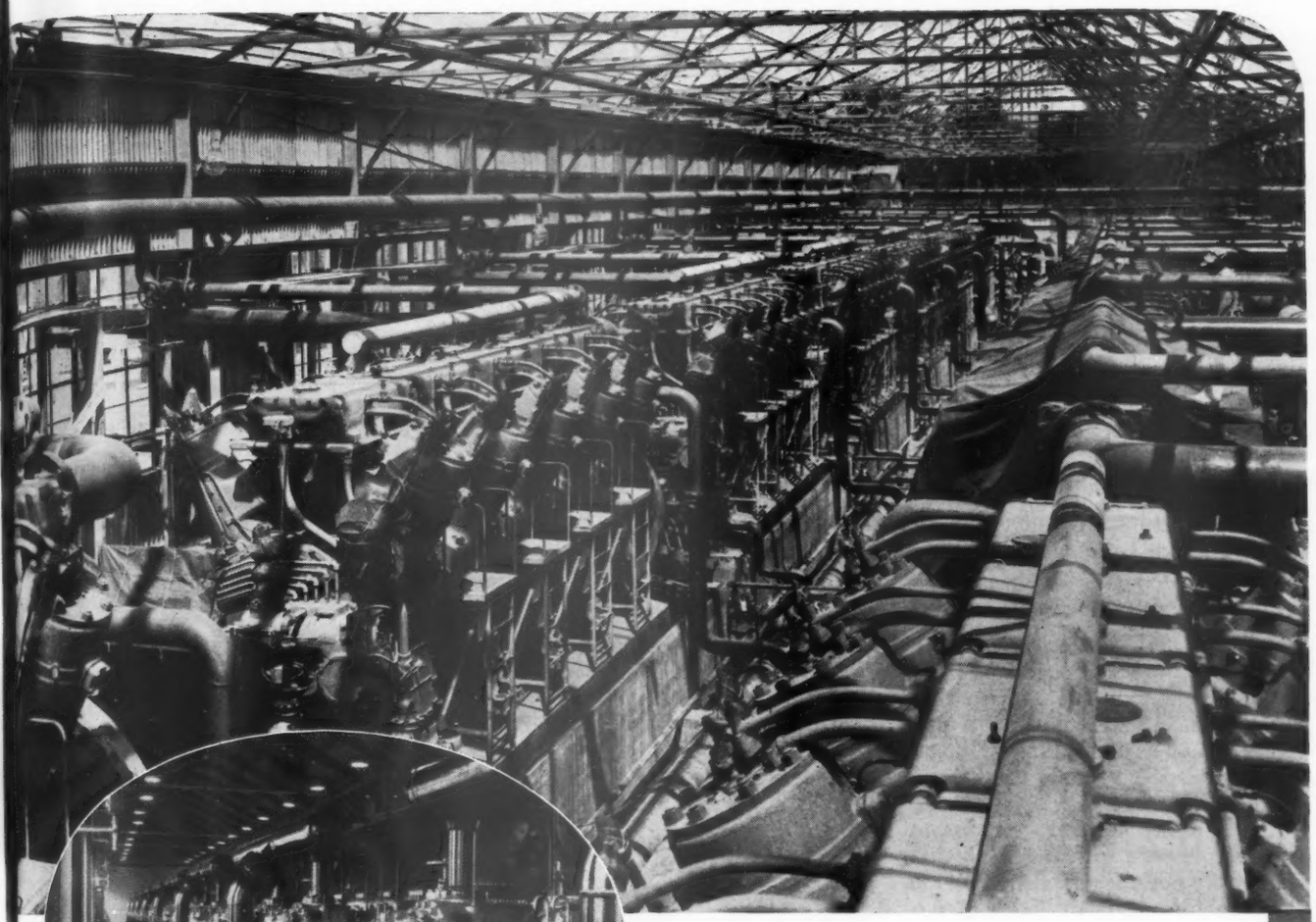
Another Example of Efficient Power at Lower Cost

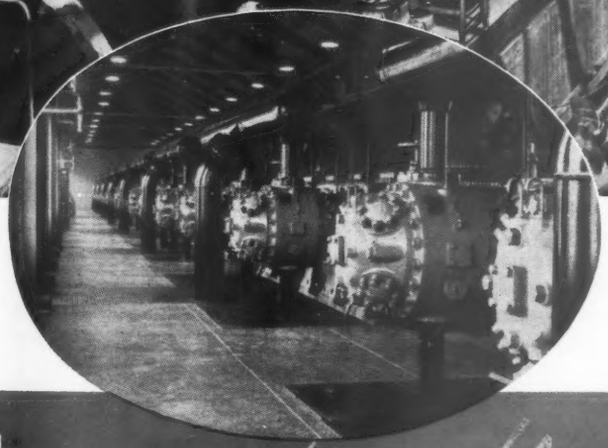


ANGLE

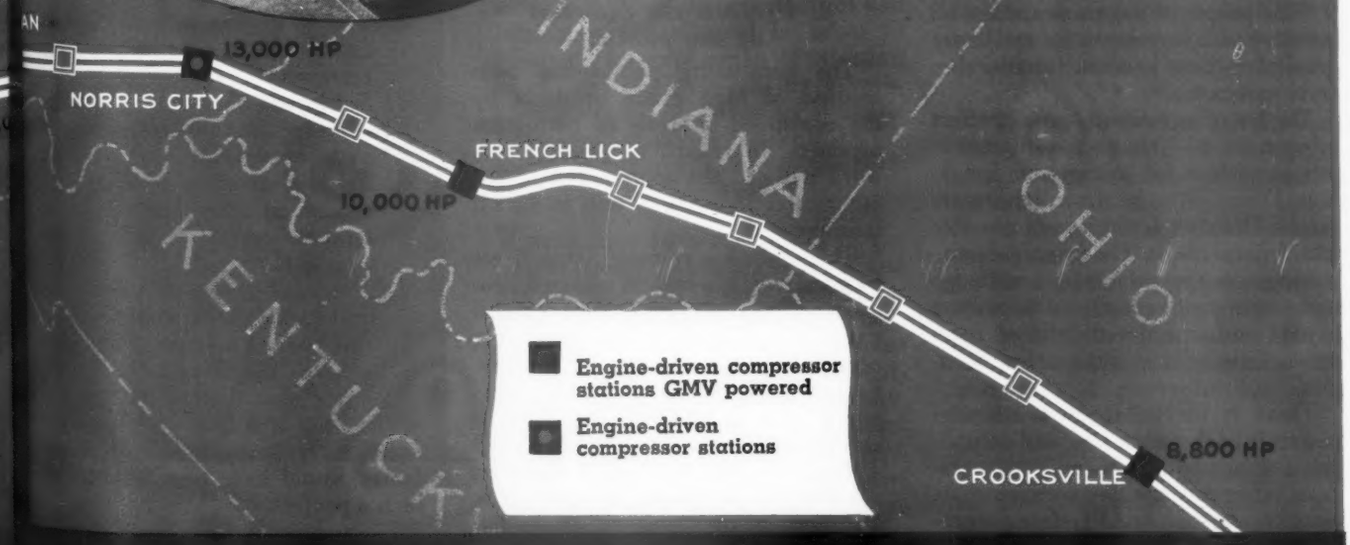
Compressors

New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash.





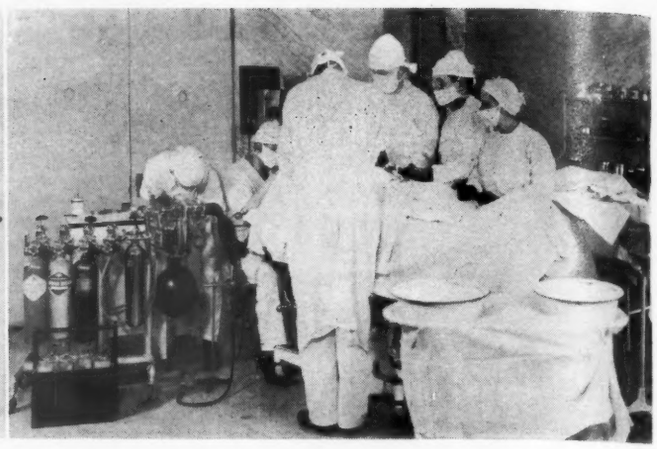
- Overhead view of 14 Cooper-Bessemer GMVs during installation at Texas Eastern's Bald Knob, Arkansas, station. Total: 15,400 hp.
- GMV 10-cylinder compressors in Texas Eastern Transmission Corporation's Hope, Arkansas, station . . . 8,300 efficient horsepower.



by Cooper-Bessemer

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Houston, Dallas, Greggton, Pampa and Odessa, Texas Tulsa Shreveport St. Louis Los Angeles



The original objective of helium research was to find safer lighter-than-air transportation, but the project has provided helium also for safer anesthetics in hospitals, safer deep sea diving, asthma relief, better welding methods and other benefits. Every person in the operating room shown above is safer because helium will not explode.

drive fields. Carpenter, Schroeder, and Cook released a report in 1943 on the Magnolia field, one selected as typical of many Arkansas reservoirs. The chairman of the Arkansas Oil and Gas Commission wrote to the Bureau of Mines Director:

..."It is my desire to express to you our pleasure with the work that has already been accomplished by the Bureau engineers in oil fields of Arkansas. To the Bureau engineers should go much credit for the advanced conservation practices we have adopted in the Magnolia field. Through their work we discovered a means to increase the ultimate recovery from the Magnolia field by at least 25,000,000 barrels.

"The people of Arkansas and the oil industry will become more and more grateful as time goes on for this concrete assistance."

The list of agreements now in effect (Appendix B)* shows the interest in this procedure for research undertakings. Funds given by the collaborators extend Division activities not possible with federal funds. The principal gain, however, is the combined knowledge and experience brought to bear upon a problem and the weight of open agreements against duplication of effort.

There is inevitable duplication of research in the extensive and complicated structure of oil and gas operations when private industry, and its associations such as API, state governments and their associations, Interstate Oil Compact Commission, schools and their research foundations all seek improved methods. Even a Chamber of Commerce gets into oil research on occasion. There is no way of avoiding some duplication and the diverse approaches provide an advantage if not carried too far. The Petroleum and Natural Gas Division is in a better position than most to know the research in progress and to correlate its activities.

7. Acts as a cohesive agent for different branches of the oil and natural gas industry.

In this role the Division has been of aid to independent companies that have confined their activities to one phase of operation. It has helped producers to learn the refining possibilities of crude oil they are extracting and helped refiners to know the characteristics of available crudes for their purposes.

8. Protects the interests of the public.

The consuming public has been assured of high grade products by the continued analysis of petroleum products. In regard to gasoline this work has had the cooperation of the automotive industry as well as the oil industry.

The public has received some direct benefits from the helium research program. The study of helium offered vague possibilities but no immediate profit and so did not interest industry. From the time the light, noninflammable gas was identified in the sun's atmosphere in 1868 helium remained a chemical curiosity until 1917 when the Bureau of Mines interested the Military in the idea of producing helium for aeronautical purposes. It received a $100,000 fund from the Army-Navy for the purpose of developing a method for the production of helium from natural gas. The substantial results of this research are still piling up. Only the length of time involved (longer because of the small staff assigned to the task) kept the results from being spectacular even to the layman.

The Petroleum and Natural Gas Division began at the very foundations and built up. A new process for extracting helium from natural gas was developed, sources were located, plants constructed, and application of the gas in various operations tested.

The price of helium was reduced from a fantastic $2500 a cubic foot to about 1½ cents a cubic foot and the quality has been vastly improved. Helium is now responsible for:

(1) Safer lighter-than-air transportation. (The original military objective.)
(2) Greatly improved methods of deep sea diving.
(3) Tracer studies in petroleum industry that accelerate important research.
(4) Safer use of various anesthetics.
(5) Almost instant relief in severe attacks of asthma.
(6) Better methods of welding.
(7) One completely new method of welding certain metals without coated electrodes.
(8) A means of detecting leaks that is so sensitive it would reveal a leak passing no more than a quart of air in 15,000 years.

No one now doubts the value of helium research but it might have been years, if ever, before private industry would have been attracted by such a project.

9. Acts as adviser to the federal government.

The results of 35 years study of our oil and natural gas resources is on tap at the Division for the use of the federal government. Sound advice is available to other units on questions that would be difficult for members of their organizations to answer.

*See Page E-29.

Perhaps it was not until the dawn of the first World War that the United States government really put the Division to use. At that time the Military and other agencies learned that they could get reliable information from the research group on petroleum. The Division has its uses in peacetime but it is during the tension and expediency of war when information is needed quickly that its substantial background is truly essential.

The large depository of tested research and checked surveys readily available from the Division is also an important stabilizing influence for both the oil and gas industry and the government. Despite the fact that it is under a political appointee, the Secretary of the Interior, it has escaped political coloring and commands a nonpartisan respect. It is able to bring legislative disputes and executive policies into better focus with its long experience and extensive knowledge.

Some arrangement should be made for a reserve fund that would permit uninterrupted research and allow for emergencies. A project should not be dropped solely because of a cut in appropriations, thereby wasting the effort already expended. The amount necessary for completion could be made available at the time the research work is begun without running into government taboos.

In several instances during the war when time counted heavily, the Division projects were hindered and even halted by the lack of comparatively small sums. Congress can keep its hands on the purse strings without doling out emergency funds piecemeal.

It seems incredible that the government's own oil research department set up by Congress should have to wait months for $15,000 to complete a needed survey on aviation fuel possibilities for war purposes. Here was a 30-year-old organization with proved ability that could supply expert advice on what was the most vital material for the war—petroleum and natural gas products. It was hampered by small appropriations and by losing time funneling information through various wartime bureaus that sprang up overnight well supplied with funds, instead of delivering the data directly where and when needed. The Division was not used as efficiently as it could have been by the Administration. Any private company would use and respect the findings of its research department but the government weighed itself down with a load of outside "petroleum experts" not connected with the Division or PAW.

We cannot go into the bureaucracy that reaches all phases of oil and gas operations in this limited discussion. We believe that a better understanding of the research Division and its setup will reveal its potentialities and intelligent action could be taken to eliminate the duplication of attention to oil and gas resources by government agencies. A real saving of public funds and of personnel could be effected by full application of the Division's experience and information.

THERE may be other phases in the phenomenal progress made by oil and gas developments in the United States to which the Division has contributed. The nine we have named cover most of the comments and opinions collected in our survey of the industry. The whole represents an unusual recommendation for democratic government. Minor in size of personnel and funds and totally without powers of making or enforcing regulations, the unit has a great and recognized influence upon what is probably the most complicated and technical industry in the country.

Below are quoted some expressions of opinion from industry leaders on the future of the Petroleum and Natural Gas Division of the Bureau of Mines:

"I hope the Bureau continues in the same cooperative way that it has in the past and that it changes in no respect, except to move forward with the industry."

"... the Bureau should continue its policy of working on industry-wide problems and should emphasize more fundamental phases of petroleum technology. It should work on problems that will be confronting the industry in the future, and should place less emphasis on problems which are decreasing in importance."

* * *

"... 1948 and the immediate years ahead present many problems of change from 'feast to famine' in which the Bureau can and should play an essential part with more emphasis than ever on secondary recovery in production and more efficient refinery methods... Many other problems are of immediate concern and ... the Bureau should and will become the same nucleus for petroleum technical thought that it was from 1915 to 1925."

* * *

"As to the future work of the Division we believe it should follow generally the pattern now set, keeping alert to improvements in technique and practice which can be generally adopted for the benefit of the industry and the public at large."

* * *

"Information obtained in a joint cooperative project (diesel fuel project) ... is very helpful, since the data will be of benefit to all concerned. Continued cooperation such as this will promote more rapid progress in developing fuels of the future."

* * *

"The future work of the Bureau of Mines should be directed toward the aims set out in the cooperative agreement between the Bureau and the North Texas Oil and Gas Association as follows:

'To conduct investigations with a view of increasing the production of oil and of bringing about a more efficient extraction of petroleum from underground reservoirs by applied technical research.' "

* * *

"With respect to the future work of the Division, we should like to see it continue its past policy of putting major emphasis on industry-wide fundamental studies; such as research on the composition of petroleum and on the physical and thermodynamic properties of its components."

* * *

"The Bureau of Mines has made worthwhile contributions to the oil and gas producing branch of the in-

Sam S. Taylor

The newest office of the Bureau at Franklin, Pennsylvania, has an experienced supervising engineer in Sam S. Taylor. He has been a Bureau staff member since 1929, when he began his work at the Bartlesville, Oklahoma, station. His research record in oil production problems made him well qualified for his present post.

Taylor is a native of Tennessee and received a B.S. in chemical engineering from the University of Alabama in 1928.

dustry in North Texas by assembling and correlating information that probably could not have been accomplished by individual persons or operators. This type of factual and impartial technical work should be continued as a valuable public service."

* * *

"The work (of the Division) is so good and . . . so well organized that it is planned that part of the work on the API Project on Sulphur Compounds in Petroleum will be carried out either at the Bureau of Mines' Laboratories or in collaboration with them. Information on these sulphur compounds is a pressing need of the Petroleum industry."

* * *

"The Bureau of Mines' Petroleum and Natural Gas Division can be very helpful in the future by disseminating reports on new operating techniques being practiced throughout the country and making the results known to the industry as a whole. This would apply not only to gas injection and water-flooding to increase recovery, but to improved drilling and production practices. . . . There are many projects that could be carried on by the Bureau, such as improved methods for sampling reservoir oils and coring techniques to determine true interstitial water."

* * *

"In the field of research there is a definite need for the Bureau."

* * *

". . . their work would be far more valuable if they put more effort into the study of the secondary recovery of oil. . . . For example, a study of the Bureau in 1924 indicated that it would be possible to mine oil sands at a cost that is certainly comparable and probably cheaper than the cost of making synthetics from shales and coal. Our reserves of oil can be more than doubled if it can be demonstrated that it is mechanically feasible to mine the oil sand."

* * *

"In view of the importance of corrosion, it seems desirable that the Bureau of Mines assist in research, which would be justified either as a preservation of property, or as a safety measure in the operation of pressure vessels, in which leakage or failure could cause serious hazard to employes or damage to property."

* * *

"The work of the Division is continuing in the study of gas production problems and there is yet a lot of work to be done along this line, particularly in regard to the flow of two phase fluids."

▸ **Conclusion.** In the foregoing study of the Petroleum and Natural Gas Division of the Bureau of Mines we find that:

(1) The value of present projects of the Division and its past accomplishments strongly indicate a worthwhile future for the research body. The industry, insofar as it is familiar with the work of the Division, favors a continuation of its program with expansion of some of the projects, such as secondary recovery and tightening of others, such as using company analyses of crudes where possible.

(2) The Division should redouble its efforts to avoid any duplication of effort in the research field and should speed up distribution of reports on concluded projects to expedite use of improved methods.

(3) The Division could be more frequently consulted to good effect by both executive and legislative branches of the government.

(4) Funds should be appropriated with the purpose of affording continuity of the research program and providing for emergency projects.

▸ **Acknowledgment.** We have used to some extent the entire bibliography of the Bureau of Mines on petroleum and natural gas. The engineering staff of the Division has given invaluable aid and has shown itself as unbiased in its appraisal of its own work as it has been in its approach to research problems.

Scores of oil and gas company executives have expressed their candid opinion of the Division. Large and small operators were good enough to give considerable thought to the operations of the government research body and report their conclusions. Usually more than one company official gave his views and in several instances companies provided digested statements of groups of their executives.

Companies whose staffs contributed invaluable discussion of the Petroleum and Natural Gas Division's activities include:

Amerada Petroleum Corporation, Argo Oil Corporation, Belridge Oil Company, The British-American Oil Producing Company, Brundred Oil Corporation, The California Company, The Carter Oil Company, Chase National Bank, Cities Service Oil Company (Delaware), Colorado Interstate Gas Company, Consumers Power Company, Continental Oil Company, Cosden Petroleum Corporation, J. E. Crosbie, Inc., Deep Rock Oil Corporation, The Derby Oil Company, Devonian Oil Company, Esso Standard Oil Company, Danciger Oil & Refining Corporation, General Petroleum Corporation, Great Lakes Pipe Line Company, E. N. Griswold, Gulf Oil Corporation, Holly Oil Company, Honolulu Oil Corporation, Independent Oil Men's Association of New England, Inc., Interstate Oil Pipe Line Company, Lion Oil Company, Lone Star Gas Company, Magnolia Petroleum Corporation, Mercer Oil Company, Mountain Fuel Supply Company, National Petroleum Association, National Petroleum Council, North Texas Oil and Gas Association, The Ohio Oil Company, Phillips Petroleum Company, Plantation Pipe Line Company, The Pure Oil Company, Quaker State Oil Refining Corporation, Shell Oil Company, Sinclair Oil Corporation, Skelly Oil Company, Socony-Vacuum Oil Company, Sohio Petroleum Company, South Penn Oil Company, Southeastern Oil, Inc., Southern California Gas Company, Standard Oil Company of California, Standard Oil Company (New Jersey), Stanolind Oil and Gas Company, Stanolind Pipe Line Company, Sun Oil Company, The Texas Company, Union Oil Company of California, Union Producing Company, Universal Oil Products Company, Western Oil and Gas Association, Western Petroleum Refiners Association.

As coordinator of these considered opinions of the industry we are deeply grateful to those who made the really important contribution to this study. Without the frank appraisal given by leading oil men there would be no possibility of judging the actual worth of the Division.

The oil industry proved it could drill into a complex politico-economic question to find the value of a governmental agency as directly as it wildcats a new area. The result was a strong vote of confidence for the Petroleum and Natural Gas Division and a list of suggestions for improvement that we have set down above. In a broader sense the analysis has brought out the fact that government-industry cooperation can be eminently successful and has been in the case of the Division and the oil industry.

* * *

This is the fourth and final article of this series on the Petroleum and Natural Gas Division. Reprints of the series will be available upon request.

See The Petroleum Engineer Continuous Tables No. 139 and No. 140, January and February, 1949, for list of Bureau of Mines publications on petroleum and natural gas. Appendixes will be found on Pages E-29 and E-30, this issue.

Simplifies Erection of Drill Rig with Arc Welding

By Mr. Harry K. Smith
The Big Three Welding Equipment Co., Houston, Texas

MANY different devices are being built by drilling contractors to speed operations of dismantling and erecting drilling rigs. Through the use of fast, simple arc welding, drilling accessories like the all welded "cat-walk" shown in Fig. 1 can be easily and quickly fabricated at low cost using conventional pipe and standard steel shapes.

The unique "cat-walk" serves three useful purposes. It carries steam and water from the boilers to the mud pump and drilling engines. In addition, the structure serves as a protected walk and as a storage rack for holding pipe and drill rig parts during transportation from site to site.

Thirty-foot sections are weld-fabricated from 6″ pipe to form the bottom runners and cross braces which are then covered with 3″ planking. Vertical members and hand rails are built from 4″ pipe with side braces of 3″ pipe, scarfed for close fit-up to runners and fillet welded to top and bottom runners with "Fleetweld 5" electrode using 200-amp. engine driven Lincoln "Shield-Arc" welders. The lower 4″ line is for steam at 300 psi. Encased in the 6″ bottom runner and the top hand rail are 2″ water lines for 150 psi pressure.

When dismantling, the couplings are merely disconnected, and the sections are skidded and loaded onto trailers. In assembly, the 30′ sections can be spotted in place and easily re-coupled with the universal fittings since all lines are atuomatically re-aligned once the walk is spotted.

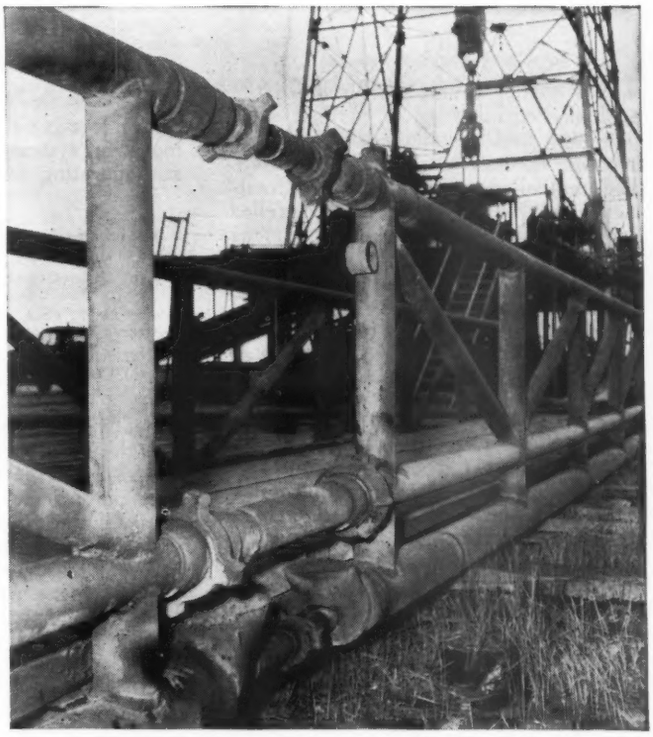


Fig. 1. Typical coupling connection between 30′ sections of an all welded "cat-walk". Bottom and top runners house 2″ pipe for transmitting water at 150 pounds per square inch. Middle runner is 4″ steam line capable of withstanding 300 pounds per square inch pressure.

Fig. 2. All welded "cat-walk" between boilers and drilling rig. Steam and water lines are located on right side. An additional water line is housed in the lower left-hand bottom rail.

Fig. 3. Rig side of all welded "cat-walk" shows pipe take-off connections for steam and water lines. Pipe fittings are arc welded to framework.

The above is published by **THE LINCOLN ELECTRIC COMPANY** *in the interests of progress. Additional information on welding pipe lines, refinery construction and maintenance are given in the Procedure Handbook. Price $1.50. Write for a copy to The Lincoln Electric Company, Dept. 182, Cleveland 1, Ohio.*

EXCLUSIVE

Cooling Water Treatment

By V. J. CALISE*

PART II

In an earlier article we discussed the problems encountered in cooling water treatment and the methods devised for avoiding excessive scaling and corrosion. The controlled scale method of treatment and control using the Langelier Saturation Index and other empirical factors were discussed. Also a procedure for calculation of the Index was given. In this article we will give three actual examples of installations using the controlled scale method of cooling water treatment and corrosion prevention.

● **Plant applications of controlled scale method.** *Plant A—Sludge-Contact Reactor plus acid.* The corrosion protection of tubes in circulating cooling water systems by means of controlled scale is finding wide application by virtue of its low cost, relative simplicity of operation, and successful results with proper operation. As an up-to-date example of development in this field, we might mention the cooling water treatment plant that is being installed at a northwestern public utility station. In this plant the cooling water is heated to 90-100 F from about 55 F by passage through heat exchange units.

Artesian well water, a clear, clean water, is being used. An average analysis of the water is the following:

	(Expressed as ppm $CaCO_3$)
$Ca++$	147
$Mg++$	96
$Na+$	57
Total cations	300
HCO_3^-	251
$Cl-$	2
$SO_4=$	47
Total anions	300

Based on experience with cooling water treatment in many plants throughout the country, we recommended maintaining a pH of 8.3-8.7 in the circulating water with sufficient concentrations of calcium and alkalinity to obtain a positive Langelier Saturation Index of 0.5-1.0. For ease of control of scale formation, we recommended a calcium content of 25 ppm and an alkalinity content of 15-25 ppm in the treated makeup water after acid treatment and the total dissolved solids in the recirculated water not to exceed 1000 ppm.

Two schemes were originally suggested for treating the makeup to the cooling water system with initial investment and operating costs as follows:

A—Lime-alum softening in a sludge-contact reactor plus acid for pH reduction—makeup 225 gpm

(a) Initial investment..... $11,300
(b) Chemical operating cost...3.9 cents per 1000 gal

B—Acid feeding alone plus sodium hexametaphosphate—makeup 300 gpm

(a) Initial investment..... $3,200
(b) Chemical operating cost...3.4 cents per 1000 gal

Scheme A has been adopted even though the initial investment is higher by $8100 and the operating cost is slightly higher. Scheme A was favored because of the greater ease of control of scale formation and because Scheme A permitted a saving of approximately 75 gpm of makeup water to the 12,000 gpm recirculating system due to concentration of the solids six times as compared to a concentration of three times for Scheme B. Also a more satisfactory effluent is produced for evaporator feed.

The average analysis of the makeup after treatment in the reactor with acid and of the circulating water in the cooling system after concentration by evaporation is as follows:

	Treated makeup	Recirculating cooling water (6 conc.)
$Ca++$	25	150
Alk A	30	180
Total dissolved solids	162	970
pH—at room temp.	6.2	8.3—8.7
Langelier Saturation Index ($pH-pH_s$)		+0.7 to 1.2 over temperature range of 70-100 F.

The Langelier Saturation Index of the water increases slightly as the water is heated in passing through the heat exchange units providing adequate protection throughout the temperature range.

The flow sheet showing the treatment of makeup cooling water for this plant is given in Fig. 4. Water from the well is first passed into a modern Sludge-Contact Reactor into which lime and alum are fed. Fig. 5 shows a cross sectional sketch of a typical Sludge-Contact Reactor unit. In this unit reaction of incoming water and chemicals is more rapidly and more completely effected by means of contact with previous accumulated sludge particles. Four features are combined in this Sludge-Contact Reactor design:

(1). Proper agitation and mixing of chemicals and water.

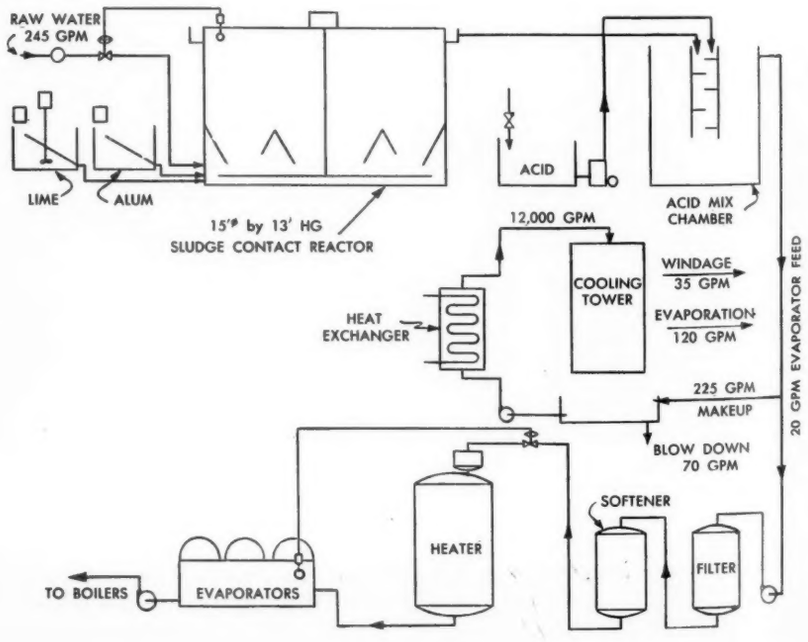
(2). Sludge-contact with a suspended deep sludge bed (blanket) of previously accumulated precipitates.

(3). Separation of the sludge from the water as the clear water emerges at the top of the unit.

(4). Sludge concentration in internal concentration compartments in order to reduce the volume of sludge blowoff water discharged to waste.

The lime reduces the alkalinity to 103 ppm and the calcium hardness to 25 ppm as $CaCO_3$. Sulphuric acid is then fed into the clearwell after the reactor to reduce the methyl orange alkalinity

FIG. 4. Flow diagram for treating cooling water at Northwestern utility.



*Technical Manager, Liquid Conditioning Corporation.

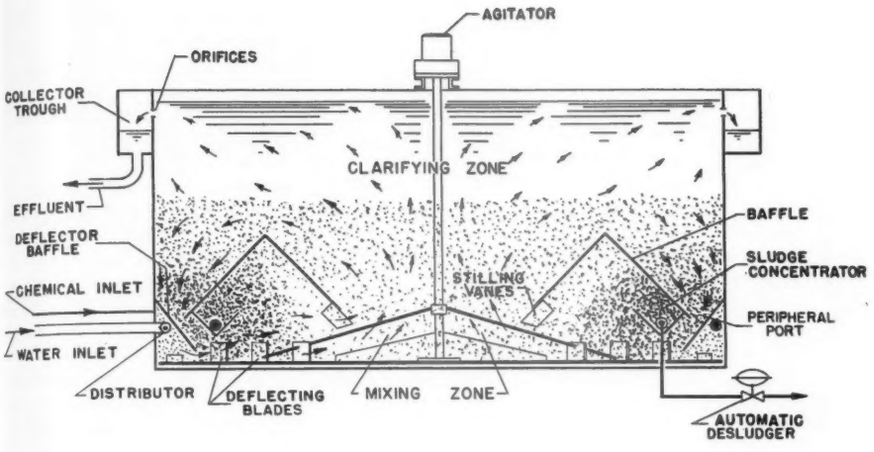


FIG. 5. Sludge Contact Reactor.

Cations	Raw influent	Blended soft and acid treated water	Recirculated cooling water
Ca^{++}	90	15	45
Mg^{++}	33	5	15
Na^{++}	181	284	852
Tota lcations	304	304	912
HCO_3^-	196	50	150
Cl^-	90	90	270
$SO_4^=$	18	164	492
Total anions	304	304	912
pH	6.5	5.9	8.4
pH_s	..	..	7.8
Langelier Saturation Index (pH—pH_s)	..	..	+0. over temperature range 70-110 F

Fig. 7 shows a cross-sectional sketch of a typical zeolite softener design with Liquon multiport valve and controls.

The sodium zeolite softener plus hard water bypass plant with acid feed was

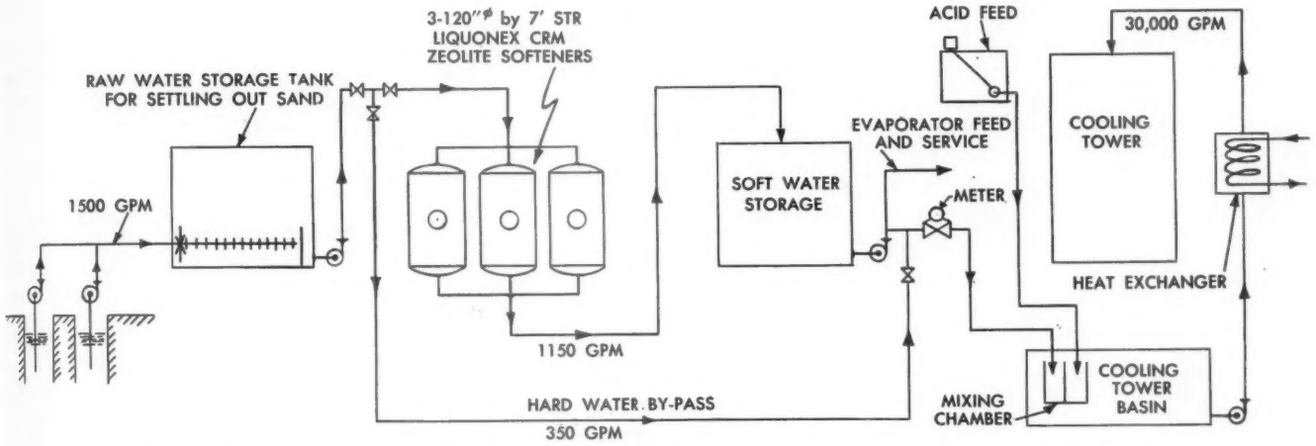


FIG. 6. Flow diagram for treatment of makeup to cooling water system at Southwestern refinery.

down to 30 ppm as $CaCO_3$. Approximately 225 gpm of the effluent is then passed into the cooling tower. Approximately 20 gpm of the acid treated effluent is passed through a filter, a zeolite softener and a deaerating heater to be used as feed water to an evaporator producing distilled water for high pressure boilers. Of the 225 gpm cooling tower makeup, 120 gpm is lost by evaporation from the tower, 35 gpm is lost due to windage or physical carryover, and 70 gpm is blown down from the cooling tower basin in order to avoid excessive concentration of solids in the cooling system beyond 1000 ppm.

Plant B — sodium zeolite softening plus bypass plus acid. Fig. 6 shows the flow diagram of a plant for treating approximately 1500 gpm of makeup to a 30,000 gpm recirculating cooling water system. The influent to the plant is a clear well water, sometimes containing fine sand, which is settled out in a raw water storage tank. About 1150 gpm of the raw water is put through three 10 ft diam by 7 ft straight Liquonex CRM carbonaceous resin zeolite softeners and approximately 350 gpm is bypassed hard water, which is blended with the effluent from the zeolite softeners to produce a blended effluent containing 1.5-2.0 gr per gal total hardness. After zeolite softening, acid is fed to the water in a mixing trough in the base of the cooling tower to depress the alkalinity. In addition to Langelier Saturation Index control, it is desirable to depress the alkalinity present in the water in order to avoid attack on wood used in the cooling towers.

The composition of influent raw well water and blended, partially softened, acid treated water, as well as recirculated water, is as follows:

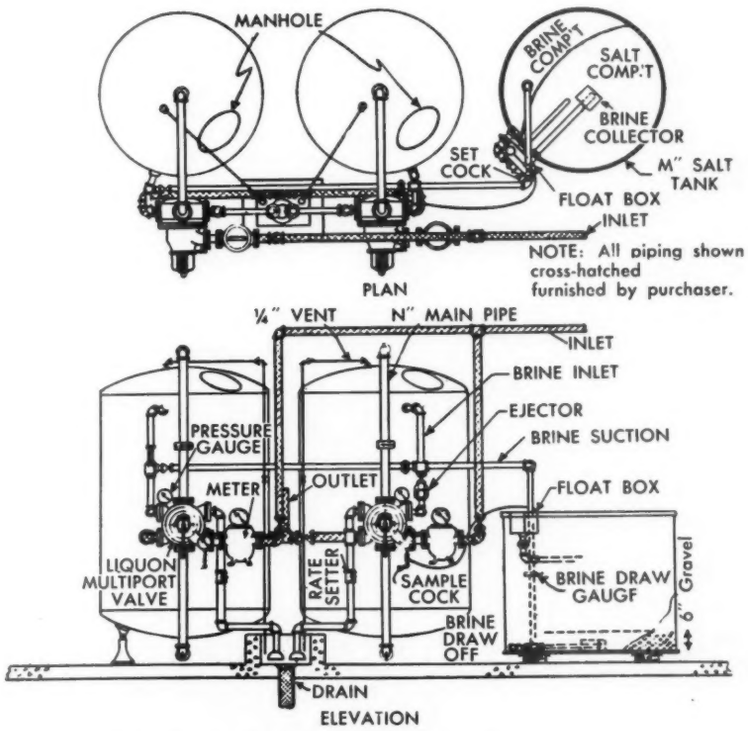


FIG. 7. Zeolite softener with multiport valve.

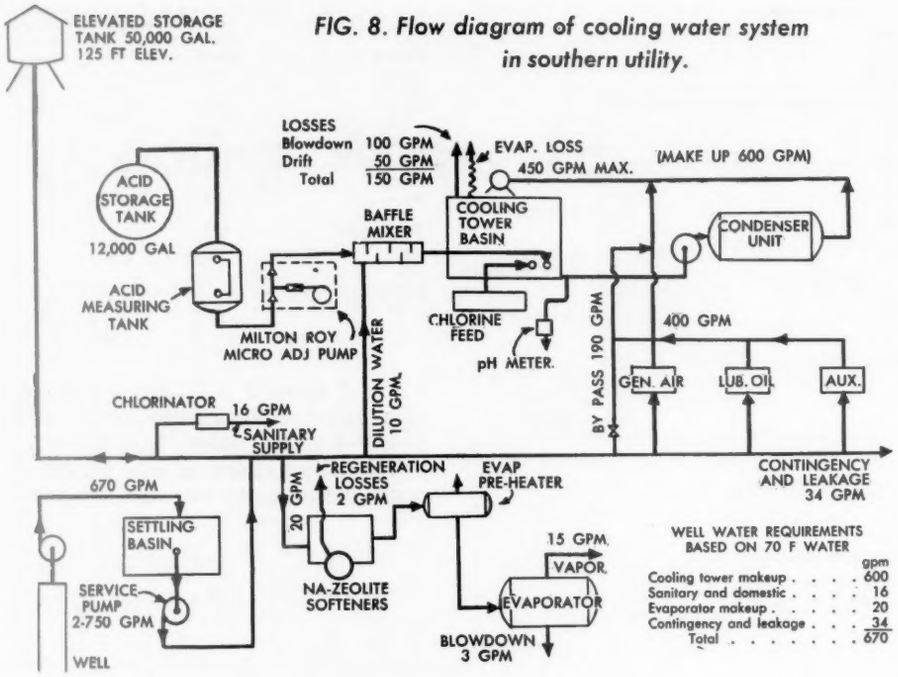


FIG. 8. Flow diagram of cooling water system in southern utility.

chosen over lime cold process plant because of greater ease of operation, availability of excess zero soft water for other plant services, evaporator feed, etc. The initial investment for Sludge-Contact Reactor plant and the zeolite plant was approximately the same, about $32,000, with about the same chemical operating cost for the zeolite softeners and for lime-treatment, i.e., about 1.2 cents per 1000 gal. This plant can also produce a pure zero soft zeolite treated water, if desired, in the system, especially where corrosion resistant alloys are used.

Plant C—acid feed. Fig. 8 shows the flow diagram of a plant for treating 600 gpm of makeup to a recirculating cooling water system in a large utility where a relatively low temperature rise of 20-30 F is expected on passage through heat exchangers. A simple pH controlled acid feed with positive displacement pump introducing acid into a baffled mixing chamber is used. The acid converts bicarbonate hardness to sulphate hardness. Chlorine is also fed to prevent formation of biological growths. The makeup water is passed once through auxiliaries on its way to the cooling tower where it is part of the condenser cooling water recirculating system. An alkali feed is provided to adjust the pH of the once-through cooling water, if necessary.

The composition of influent well water after acid addition and after concentration in the cooling tower is as follows:

	Raw influent	After acid addition	After conc. in cooling tower
Ca^{++}	110	110	440
Mg^{++}	50	50	200
Na^{+}	31	31	124
Total cations	191	191	764
HCO_3^-	175	15	60
Cl^-	8	8	32
$SO_4^{=}$	8	168	672
Total anions	191	191	764
pH	6.9	5.2	8.3
pH_s	7.3		7.2
angelier Saturation Index	−0.4	..	+1.1

*Temperature range 80-110 F.

The initial investment in equipment including pH controls for this cooling water treatment is about $4500 with a chemical operating cost for acid of 1.2 cents per 1000 gal of treated water.

● **Conditions of controlled scale process.** Generally speaking, the most satisfactory results with greatest ease of control can be obtained with the controlled scale method in recirculating cooling water systems by waters falling within the following range of composition:

(a). pH—8.3-8.9
(b). Calcium—20-250 ppm with
(c). Alk A—150-40 ppm giving a
(d). Positive Langelier Saturation index of 0.5-1.5
(e). Total dissolved solids of less than 1500 ppm
(f). Free from suspended solids, organic growths or slime, inhibitors of various types
(g). Temperature rises through heat exchangers less than 60 F. For higher temperature rises, the proper ratio of alkalinity : pH must be maintained in the recirculating cooling water to obtain uniform controlled scale deposition over the entire temperature range.

Wider variations in calcium and alkalinity as well as greater fluctuation in temperature in the cooling system apparently make control of scale deposition more difficult. There are some plants obtaining successful results with cooling water compositions outside the range given above, however.

There are a number of arrangements that can be used for cooling water treatment by the controlled scale method. These alternate methods can be classified as in Table 2.

Method 5 in Table 2 has found wide acceptance in California refineries where alloy metal tubes as well as steel tubes are used. The pH of the soft water is usually adjusted to 8.3-8.6. This method has been used for many years in these plants and, although it is more expensive, both initial investment and operating cost being relatively higher, it permits high thermal efficiencies with a minimum of care.

● **Inhibitors.** Various inhibitors are used for scale and corrosion control, the most successful being sodium hexametaphosphate (Calgon) for calcium carbonate scale control and sodium dichromate for corrosion protection. In addition to these compounds, various other phosphates and chromates are manufactured and sold for this service. Organic polysaccharides are used in some plants in the petroleum industry.

Reports on the success of these inhibitors vary. The "threshold treatment" using Calgon has been recommended for scale and corrosion control. Polyphosphates have been found successful in scale control and for many corrosion problems. Also in many municipal water systems, the "threshold treatment" has considerably decreased the rate of corrosion. The amount of polyphosphate fed varies from 3 to 15 ppm for this treatment.

Tannin has been used with phosphate

TABLE 2. Methods of cooling water treatment. Controlled scale method of corrosion prevention

(Where inexpensive corrosion protection is required usually with steel tubes—makes use of a film of $CaCO_3$ scale of controlled thickness which is thin enough so that it does not affect the rate of heat exchange appreciably but thick and hard enough to form a uniform impervious barrier on the metal, preventing attack by oxygen in the cooling water.)

Type of water	Method of treatment of raw water for cooling system	Remarks
1. High calcium, high alkalinity. Turbid colored water or water containing organic matter.	Lime treatment alone or followed by polyphosphate or followed by acid.	This is a simple, inexpensive method making use of the sludge-contact reactor. Now being used in many plants.
2. Low calcium-clear, clean water.	Acid alone.	
3. Low solids, low calcium, clear, clean water	Polyphosphate plus acid.	Used with higher temperature rises in cooling water systems where poly phosphate alone might not afford full protection. Methods 1, 2, 3, and 4 are simple and inexpensive treatment.
4. Low solids, medium calcium and alkalinity-clear, clean water.	Polyphosphate alone.	With low temperature rise in cooling water system.
5. High calcium, high alkalinity. Clean, clear water.	Zeolite softening plus hard water bypass plus acid plus degasifier plus caustic soda for pH adjustment.	Preferred where variable composition water and unskilled operators available. Zeolite units can be automatic. Also for higher temperatures in cooling system.

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for scale protection with success; however, tannin has not usually been satisfactory in corrosion control. When phosphate and chromate are used together for scale and corrosion protection, it is desirable to leave out the tannin because it is detrimental to the corrosion inhibiting action of the chromate.

There are limits to the application of phosphate, as alkalinities in excess of 500 ppm may cause scale formation in spite of the phosphate, even with tannin. The scale will be much softer and easily washed out of tubes under these conditions, however.

Chromates combine with the metal to form a chrome-iron compound film that acts as a barrier to the corrosive oxygen. Low pH values are usually specified for the use of chromate inhibitor because slightly acid conditions are favorable to the formation of the protective film. When a continuous smooth film is formed, the chromate treatment is satisfactory. In many cases, however, rust spots, oil, or dirt on the tubes cause slight holes or breaks in the film through which the corrosion proceeds more rapidly than if the tube was entirely unprotected. This is due to the fact that the oxygen concentrates on these small breaks in the protective film so that the tube metal at this point is subjected to very aggressive conditions. The acidity of the water accelerates this action. This results in pits or holes through the tubes at the point of the break.

If the concentration of the chromate is maintained high enough at 500 ppm or higher and other inhibiting materials are not present the breaks in the film can be repaired. This method has been found to yield satisfactory results in many plants[8] but it is more expensive than the controlled scale method.

Some oil refineries have had good results with glucosates for corrosion protection.

TABLE 3. Methods of cooling water treatment. No scale formation at all.

(Where scale prevention alone is required and corrosion of metal by oxygen is reduced to a minimum in some cases by use of non-corrodible alloy tubes or where combinations of non-corrodible alloys and steel tubes are used in a system.)

Method of treatment of raw water for cooling system	Remarks
1. Zeolite softening alone, or with bypass.	Used in many California oil refineries with proper blow-off for control of alkalinity and solids concentration in this circulating cooling water. Can also be used with thin layer scale to protect metal. Formation and thickness of scale controlled by blow-off or by acid feed or carbonation. Zeolite softening alone usually employed only with alloy tubes.
2. Zeolite softening, plus vacuum deaeration to remove oxygen.	For closed systems only with alloy and steel tubes.
3. Zeolite softening plus corrosion inhibitant such as sodium dichromate.	Methods 2 and 3 are expensive treatments usually employed where maximum and unvarying thermal efficiency required with a minimum of care and also where some steel tubes or surfaces are in contact with cooling water.

● **Cold water deaeration.** For many plant applications, it is too costly or impractical to add corrosion-inhibiting chemicals to the water. This is particularly true for extremely corrosive waters having low hardness and alkalinity and where large quantities of water are to be treated. Vacuum deaeration is particularly applicable to such waters.

Such cold water vacuum deaerators have been installed to protect long pipe lines, to reduce corrosion and maintain heat transfer in cooling equipment, and to reduce corrosion in process water distribution systems where zeolite-treated or demineralized water is handled.

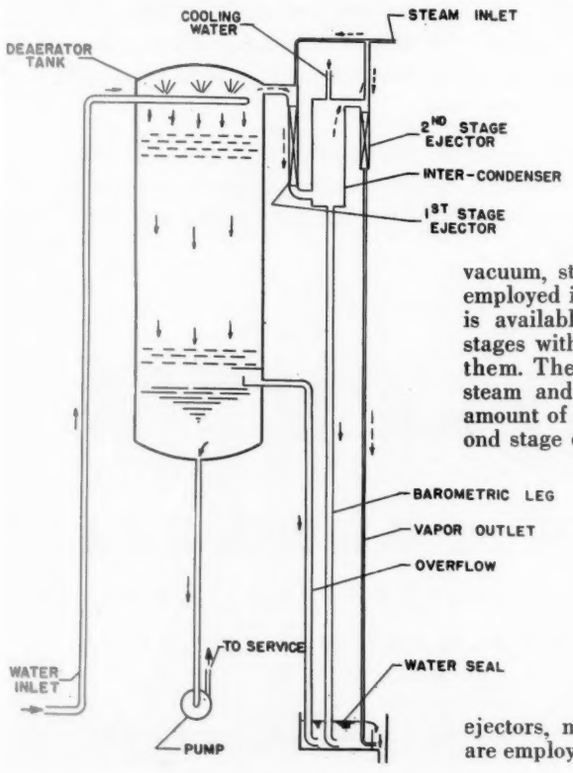
Fig. 9 shows a typical design of vacuum deaerator that removes oxygen as well as other dissolved gases. Steam is not usually employed to heat the water as in the deaerating heater but the same conditions must be fulfilled, namely:

(1). The pressure maintained must correspond to the boiling point. Therefore, at cold water temperature, a vacuum must be maintained.

(2). The water must be broken up into thin sprays and films to permit the release of the dissolved gases from the exposed water surfaces.

To create the necessary vacuum, steam jet ejectors are usually employed if steam of adequate pressure is available. The ejectors are in two stages with an inter-condenser between them. The condenser, by condensing steam and water vapor, reduces the amount of gas to be handled by the second stage ejector and thus saves steam. The two stages act as a multi-stage pump. The first stage raises the absolute pressure of the withdrawn gases and water vapor part of the way, and the second stage then boosts the pressure the rest of the way to atmospheric pressure. Where steam is not available for ejectors, motor-driven vacuum pumps are employed.

FIG. 9. Vacuum deaerator.



Due to the slower attainment of equilibrium at low temperatures, a considerable height of column is required for the vacuum deaerator shell. The water is first sprayed at the top and then trickles down in thin films over a fill of staggered non-corrodible trays or slats.

Barometric legs are employed for the cooling water outlet of the inter-condenser and for the overflow from the deaerator tank. These legs have sufficient depth to seal the vacuum in the deaerator and allow for gravity flow to the atmosphere.

● **Prevention of excessive scale formation.** The chemical treatment methods for avoiding excessive scale formation are summarized above.

In some plants, the controlled scale method of corrosion prevention may not be desirable because of operating limitations and very high heat transfer efficiencies that must be maintained continuously, simultaneously with high temperature rises in the heat exchangers. Also in many plants, particularly oil refineries on the West Coast, non-corrodible alloy tubes or combinations of alloy and steel tubes are used in one plant. Under these conditions, zeolite softening alone or in combination with vacuum deaeration or inhibitor addition can be used. In Table 3 are summarized these alternate methods for treating water in this manner.

These methods give satisfactory results with minimum care but usually at higher initial investment both for non-corrodible alloy tubes and water-treating equipment and also with higher chemical operating cost. These methods are usually employed where plant processes and construction materials are such as to justify their use by overall economy of operation.

● **Bibliography**

1. C. R. Cox, "Water Purification for the Practical Man."
2. W. F. Langelier, *Journal of American Water Works Assoc.*, 28, 1500-1521 (1936).
3. Charles P. Hoover, *Journal of American Water Work Assoc.*, 30, 1802, (1938).
4. T. E. Larson and A. M. Buswell, *Journal of American Works Assoc.*, 34, 1667 (1942).
5. S. T. Powell, H. E. Bacon. and J. R. Lill, *Ind. Eng. Chem.*, 37, 842 (1945).
6. Ibid, *Journal of American Water Works Assoc.*, 38, No. 7, 808 (1946).
7. S. T. Powell, H. E. Bacon, E. L. Knoedler, *Ind. Eng. Chem.* 40, No. 3, 453 (1948).
8. W. H. Attwill, API Proceeding, III 22:93 (1940) *Nat'l Petroleum News* 33:26, R201 (1941).
9. W. F. Langelier, *Journal of American Water Works Assoc.*, 38, 169 (1946), 38, 179 (1946)

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TO MARK PROGRESS

Petroleum Profile

W. C. KINSOLVING
President
Sun Pipe Line Company

W. C. KINSOLVING, president of Sun Pipe Line Company (Texas) and Susquehanna Pipe Line Company, seems to have been destined for the oil industry. Son of an oil-field worker, born at Corsicana, Texas, he was reared in the atmosphere of oil.

"I got my first smell of oil when I was six months old when dad took me from Corsicana to Beaumont to see the Lucas gusher, Texas' first big oil well, brought in during January 1901," Kinsolving says. That must have been the beginning. In any event, there apparently never was any doubt in his mind regarding what his life's work would be, because immediately upon receiving a degree in electrical engineering from Cornell University in 1923 he joined Sun Oil Company as an oil-field hand.

Advancing through various stages of oil-field work, he eventually was placed in charge of the construction of a products pipe line in the East in 1930-31. He returned to Texas to direct the construction and operation of a crude oil pipe line from the newly discovered East Texas field to the Gulf Coast.

In 1942 he was called to Washington to serve as assistant director of transportation for the Petroleum Administration for War. In this capacity he figured prominently in the planning and construction of the "Big Inch" pipe line from Texas to the Eastern Seaboard. Later he was commissioned a colonel in the Army Corps of Engineers and played a prominent role in the building of the China-Burma-India pipe line. Upon completion of his war service he returned to Sun Oil Company as manager of all pipe line operations. Subsequently he was elevated to his present position.

Although Kinsolving's life has been filled with achievements, one of the outstanding memories about which he likes to reminisce is the part he played in laying the China-Burma-India line during the war. "That pipe line was the screwiest, most unorthodox pipe line ever laid down," he recalls. "We'd never put such a cockeyed pipe line in the ground in the U. S. A. But it did prove there isn't any place in the world where Americans can't string a line."

Kinsolving's part of the CBI project was the 1500 miles from Tinsukia to Calcutta, with a branch to the VLR (Very Long Range) airfields west of Calcutta. The line crossed the Ganges, Brahmaputra, and Hooghly rivers. Its route was through the "wettest spot on earth," the Brahmaputra Valley north of Calcutta where as much as 400 inches of rain falls each year. The crossing of the Brahmaputra River was made at low water—when the river was only a mile and a half wide and 50 feet deep!

Despite the high post he occupies, Kinsolving still likes to think of himself as just a "pipeliner." A pipeliner, for the enlightenment of the uninitiated, is a rugged, clannish breed of individuals and to be called one is indeed a mark of distinction. A true member of this unusual fraternity must have a nickname, which serves as a sort of badge to attest to membership. It is understandable, then, that Kinsolving gets his greatest satisfaction when another member of the clan greets him with a "Hi, Kingfish!" He knows by this salutation that he is still considered a "pipeliner."

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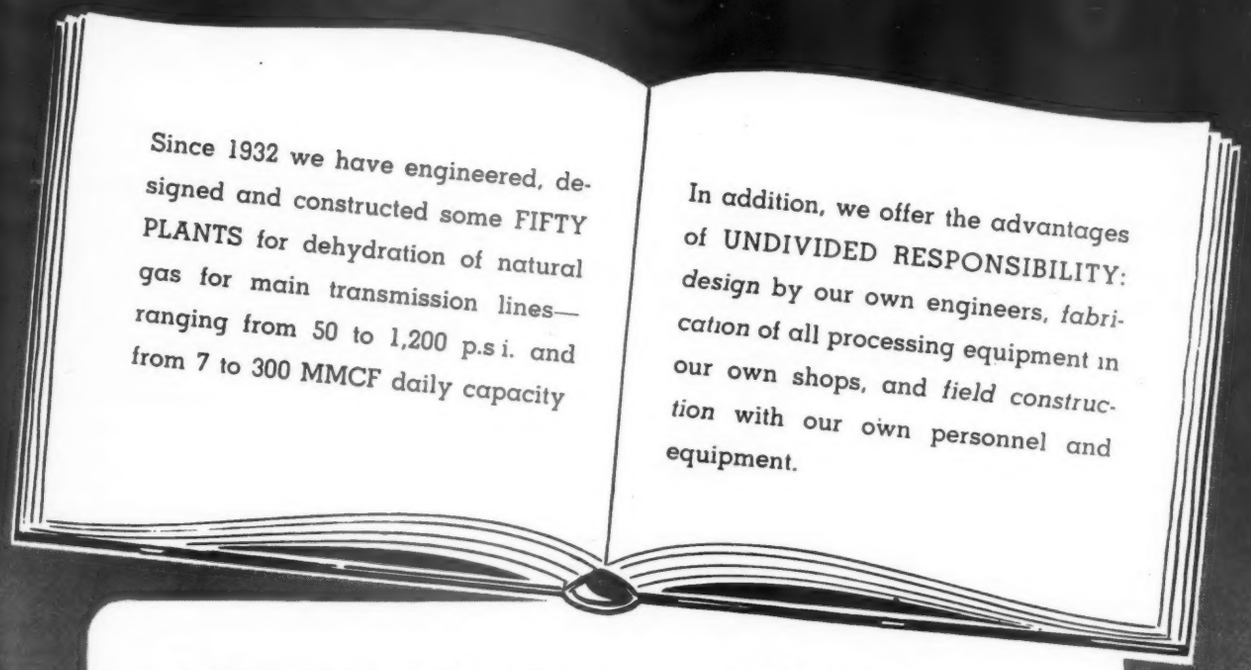

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LAUGH WITH BARNEY

The absent minded professor and his absent minded wife were spending a quiet evening at home when someone banged on the door. She yelled, "O Gosh, my husband!" And he jumped through the window.

* * *

African Hunter: While wandering around a native village I spotted a leopard.

Sweet Girl: Don't be silly. They grow that way.

* * *

Pat and Mike were working on a new building. Pat was laying bricks and Mike was carrying the hod. Mike had just come up to the fourth floor when the whistle blew. "I hate to walk down," he said.

"Take hold of this rope," Pat said, "and I'll let you down." Pat let him down half way and then let go of the rope. Mike landed in a mortar bed, not much hurt but angry.

"And why did you let go of the rope?" he demanded.

"I thought it was going to break," said Pat, "and I had presence of mind enough to let it go."

* * *

Mr. Cutting: Woman is nothing but a rag, a bone and a hank of hair.

Mrs. Cutting: Man is nothing but a brag, a groan and a tank of air.

After the physician had checked him over, he asked the patient:

"Have you been living a normal life?"

"Yes, Doctor."

"Then you'll have to give up women and whiskey for a while."

* * *

Newspaper ad: "The ladies of the Biscoe Methodist Church have discarded clothes of all kinds. Call at 44 North Main Street and inspect them."

* * *

The new attendant at the spiritualist circle had formerly been employed in a big drapery shop. The fact came to light when a client requested him to tell the medium she wished to speak with Mr. Green.

"Certainly, madam," said the attendant. "Can you give me his Christian name?"

"I'm afraid I've forgotten it, but he died only a short time ago."

The attendant cleared his throat and approached the medium.

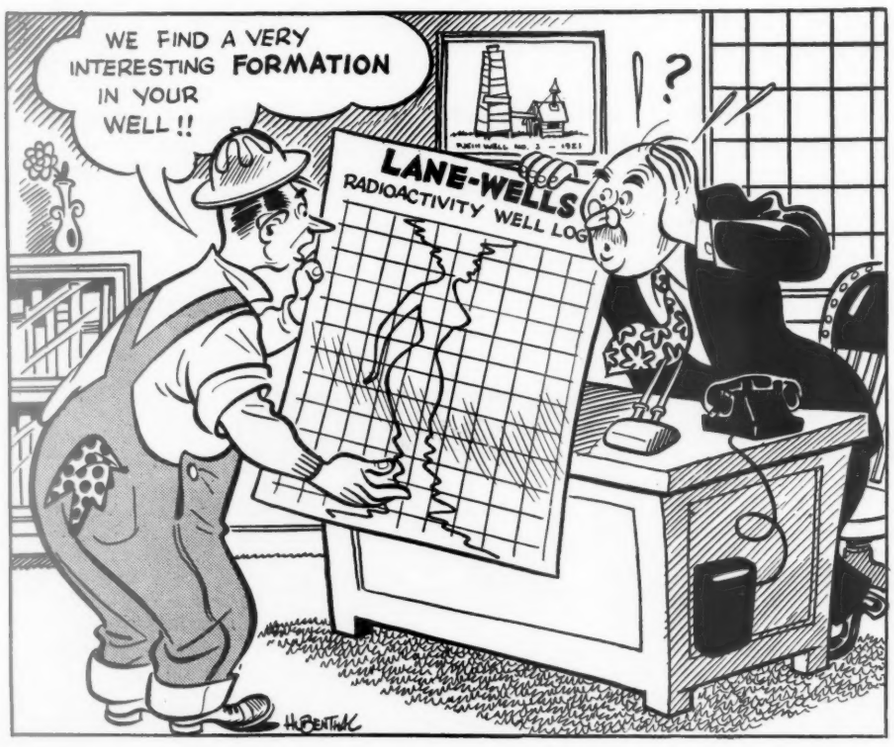
"Please show the lady some of the latest shades of Green," he said.

* * *

Mamma Bear: Somebody's been drinking my whiskey.

Papa Bear: Somebody's been drinking my gin.

Baby Bear: Hic!



Mrs. Jones was spending a day in bed with a severe cough, and her husband was working in the back yard, hammering nails into some boards. Presently a neighbor came over to the yard.

"How's the wife?" he asked.

"Not very well," said Jones.

"Is that her coughin'?"

"No," replied Jones, "It's a chicken house."

* * *

"Is your husband tight?" asked Mary.

"Is he?" responded Rae. "Say, every time he takes a penny out of his pocket the Indian blinks at the light."

* * *

"My husband runs around at night. Can you suggest a way to keep him at home?'"

"Some use window weights and others hammers. Personally I would suggest a pink negligee."

* * *

Hotel Manager: "Did you find any of our towels in that man's suitcase?"

Hotel Detective: "No, but I found a chambermaid in his grip."

* * *

Her car stalled at the corner, and the traffic light kept changing—red, yellow, green, red, yellow green.

The policeman stepped over to the car and asked in a hurt voice: "What's the matter lady, ain't we got any colors you like?"

* * *

A stingy husband, while out of town, sent his wife as a present a check for a million kisses. The wife, a little annoyed, sent back a post card: "Dear Jim, thanks for the birthday check. The milkman cashed it for me this morning."

* * *

Two passengers were overheard in a literary discussion on the Brooklyn express. One asked the other what his favorite reading was and the other replied, "Popeye, Superman, and Flash Gordon."

When asked if he liked O. Henry, the other said, "Naw, the nuts get in my teeth."

* * *

A man met a friend on the street, all bandaged up and walking on crutches.

"What happened?" asked the friend.

"Well, I had a date with my girl. We were dancing to the music of the radio, and you know how deaf the old man is."

* * *

Prosecuting Attorney: "You mean to say you had sixteen beers and didn't move once from the table the night of the murder?"

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PETROLIC PERSONALITIES

DICK SNEDDON

We open the column this month on an aesthetic note, having been informed by a little bird that J. Delbert Jones, master mechanic in Gulf Refinery Company's Tulsa pipe line division, is one horticulturist who really loves to dilly among the dahlias. He is grand chief invincible potentate, or something, of the local Dahlia Society, and at the 1948 show made a grand sweep with 23 of his entries winning places out of a total 25 classifications.

That is sheer monopoly if we ever saw it, and we are sending word immediately to Washington so that suitable investigation may be made! Incidentally, we understand that J. Delbert often comes up with a brand new species of dahlia which he names after some prominent citizen. When it was announced recently that he had perfected a pink specimen with a wide yellow streak, four doubtful characters promptly left town.

The news out of Wyoming and the mountain states is terrific. Oil men have been having a rugged time for the past six or seven weeks. Supplies have had to be flown in to camps and drilling sites on ski-equipped planes, which from all accounts have been doing a swell job. It is even rumored that Clyde Parrish, the Sinclair Pipe Line superintendent, was seen out in the wilds a short time ago tracking down a deer, and the snow was so deep they were both standing still. Clyde, by the way, has to cover four mountain states—Wyoming, Utah, Montana and Colorado—and in view of the weatherman's careless handling of the local situation is seriously thinking of turning in his car on a late model bulldozer.

A few years ago, there arrived in Austin, Texas, for a big powwow with the Railroad Commission, two perfectly rational individuals, to wit, Don Attaway, safety engineer for Arkansas Fuel Oil Company and Arkansas-Louisiana Gas Company of Shreveport; and Bob Garrett, head of the production engineering department of Arkansas-Louisiana. They had a double room in the Driskill Hotel, and having in due course finished their chores with the Commission, they repaired to the room with a few friends for a bit of idle chatter.

One of the guests remarked during the evening that the two hosts wore suits very much alike, but the fact occasioned no further comment. Early next morning Bob rose, dressed without waking Don, and caught an early plane for Houston, Texas. Later in the day, Don hied to the railway station to catch his train for Shreveport. He reached into his inside pocket for his railway ticket, and found instead a plane ticket to Houston. They had exchanged jackets—and if they hadn't been nice honest looking people would probably have had to appear before the Railroad Commission—this time for a quite different purpose.

Howard Robinson, Union Oil Company's pipe line manager, did an outstanding job as chairman of the San Luis Obispo grand jury, from which assignment he was just relieved last month. Howard was somewhat disturbed a few years ago, we remember, when some South American visitors referred to him as the "superintendent of tubes." Being a broad minded fellow, however, he finally realized that there is no basic difference between a pipe and a tube—they are both just long cylindrical holes with some metal around them. After that he didn't mind any more. It is reported in certain quarters that after many years of exemplary behavior, Howard has actually taken to golf, and is now doing his own ditching.

Harking back to the jury business, George Trembley, the lad whose prowess with a cue makes Willie Hoppe tremble in his boots, has also just finished a tour of duty as a juryman. and Mo Johnston who could use all the time he has got right now, is beginning a session on the Los Angeles grand jury. Which reminds us of the chap who tried to beg off jury duty. "Why," he said, "it wouldn't be fair of me to serve. I'm biased. The very look of that guy convinces me that he is a crook." "Ssh!" said his lawyer, "That's the district attorney."

From what we hear, Gil Rowe, vice prexy of the Rowan Drilling Company at Fort Worth. handles a nifty niblick, and for that we envy him like everything. We never became any great shucks at the game ourself, perhaps because we were forced into it to begin with. Our boss, a cruel man, said it was our last chance—we either had to quit or else hit the ball. It turns out that Hudson Drake, the Belridge p.a., is not only an unusually adept purveyor of the titivating waters, which he demonstrates at every Petroleum Production Pioneers' function, but he also plays the trumpet with *savoir faire, esprit de corps*, and *pate de foie gras* (French inserted at no extra cost). He has, indeed been proposed as a stand in for Harry James, and is going to see Betty Grable about it.

Jack Laudermilk, of Socony-Vacuum at New York, who used to be head of the department of engineering at University of New Mexico, is another oil man who really gets around. He skips back and forth between the Big City, Colombia, Venezuela, and the Middle East without so much as the beetling of an eyebrow. Like most flyers, however, he will probably admit that although he loves to zoom through the air, he is always glad when he gets his feet back on vice versa, or is it terra cotta? again.

Bill Sargent, erstwhile football mentor of Loyola U, ex-professional coach, and platform orator extraordinary, has given up campus glamor, and returns to the oil business via Sargent Engineering Corporation. Bill is really a top performer and we can certainly recommend him to program chairmen who, it is our experience, are constantly looking for entertaining after-dinner entertainers who are after a dinner to entertain after, if you get the idea. Bill is making a trip to South America right quickly, and will have Jerry Engstrand as traveling companion. That will obviate for him the necessity of going through the embarrassing situations that usually have to be faced on a first jaunt to the Latin Americas. Jerry will see that Bill doesn't get into any of the old troubles, and will probably introduce him to some new ones.

Comes late word that Sid Levine, the livewire prexy of Santa Fe Tank and Tower Company out on the Coast, recently went on a mixed business and pleasure voyage to Honolulu, and before weighing anchor joined with his staff in a right enjoyable champagne hour aboard the good ship *Lurline*. We are told that besides trying out the Island fairways—Sid is a good enough golfer to have crossed niblicks with Bobby Jones—he looked very intently into the cooling tower situation down below, and it is even hinted—ssh!—that he took a gander at the grass skirt situation. This journey was the satisfaction of an age old yen for Hawaii and its quaint customs. Indeed, ever since Sid was knee high

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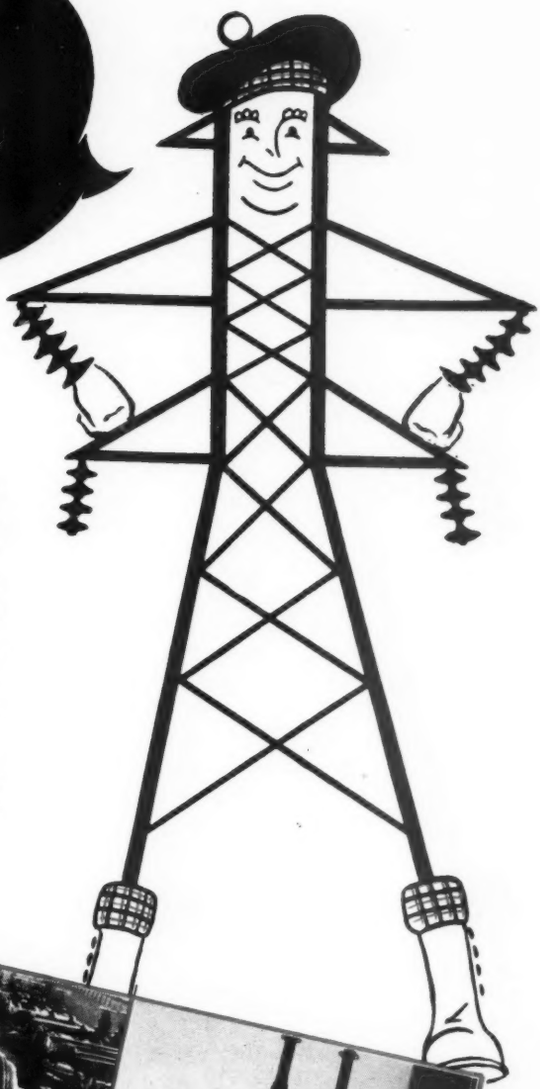

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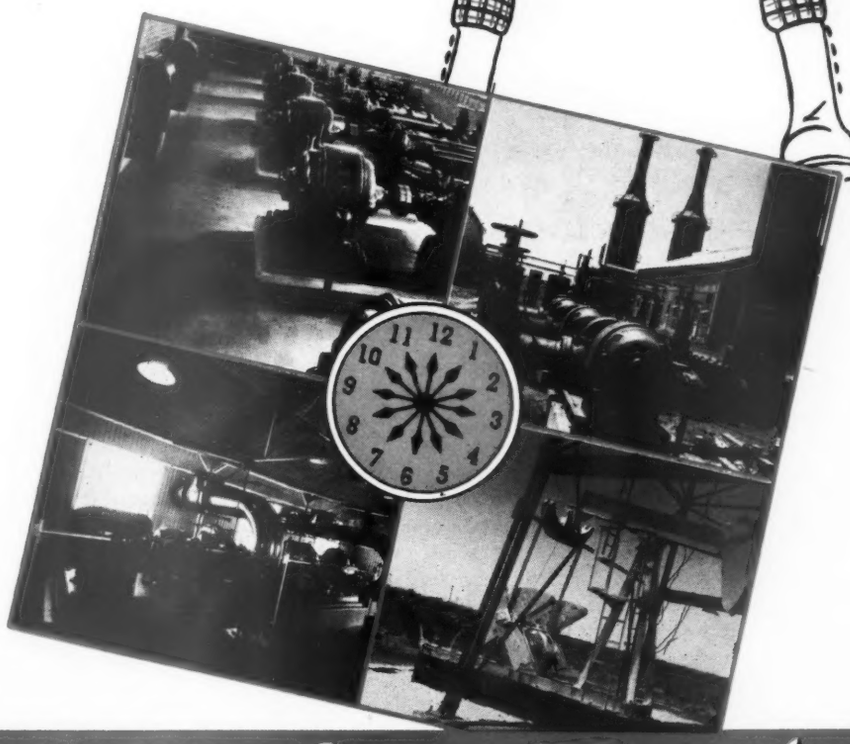

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to a cooling tower baffle plate, he has been terrifically fond of poi—you know, apple poi a la mode. Our best information at the moment is that he is back at the Crestview Country Club, much refreshed by the sea breezes, and has taken to wearing hibiscus blossoms in his hair.

We have an authoritative report that D. M. "Mac" McKinney, Rice alumnus of an early vintage, and office engineer with Humble Pipe Line Company, has been "lend-leased" to his long time friend Charlie Adoue of the Creole Petroleum Corporation for work on that company's "steepest-inch" line in Venezuela. Photos received by his friends in Houston office would indicate that life in the extremely deep south, and the rigors of jeep transportation, have dissipated Mac's surplus tonnage and slimmed him down to the sylphlike proportions of a gazelle. 'S becoming too! From the same information source comes a dramatic account of hectic preparations by Captain Wayne Caleb Morriss for the voyage of his young life.

The Captain, after 21 years of service as pilot, and later port captain, at Harbor Island Terminal, Houston, retires March 1, and has more travel ideas than a tourist bureau. For some time he has been fitting out a house trailer with an anchor, a Plimsoll mark, and the last word in modern conveniences. Anon, or perhaps a little later, he expects to take a reef in the main halyard and set sail with a crew of two—Mrs. Morriss and their 3-year-old son—on a cruise into the interior of the United States. Just a short time ago, the Captain celebrated the conclusion of his long service at Harbor Island by docking the biggest tanker afloat—Standard of Jersey's "Esso Zurich." For ten years before settling down to shore duty he was a deck officer of Jersey's tanker fleet.

Ed Turner, popular prexy of Pan American Producing Company, originally from Madisonville, Texas, has been prominent in Southwest drilling and production circles for lo these many years. He has fared far afield in his search for the black gold, and now it has been found virtually in his old backyard at Madisonville. It is a great comfort to a man in a case like that to go back to the old stamping ground and find that none of the other home folk got in on the play either. The discovery is usually made by a total stranger, financed by foreign—out of town, that is—capital. They seem to be a pretty civic minded bunch these pipe liners. We note that Fred Simms, retired pipe line manager for Shell out on the Pacific Coast, has been chosen one of the five new advisory directors of the Kern County Chamber of Commerce. Fred lives on his cattle ranch out at Weldon, and with sirloins at their present price ought to be doing all right. One thing especially appealing about a cattle ranch is that the cattle don't have to be hoed.

We hear tell that Neil C. Needham, one of the best known lands and leasing men in California, is just resting briefly prior to setting up in business as a consultant. Neil, who headed General Petroleum Corporation's land department in a very capable way for many years, probably inherited some at least of his oil acumen. His father, H. Clay Needham was a pioneer operator, who drilled on the family property at Newhall as early as 1904—some of the wells, indeed, drilled at that time are still producing.

A part of the Needham property was sold about 1925 to the Pioneer Petroleum Society for the purpose of instituting there some sort of a memorial to the pioneers of the petroleum industry. W. W. Orcutt was the prime instigater of that movement, but since his death, the old Pioneer Society has almost ceased to function, and little of its program has been accomplished. Neil is a member of the more recently formed Petroleum Production Pioneers, and evinces a lively interest in its objectives. Another of his interests is books, and we culled this advertising gem by the Swiftsure Stage Line, from the Wilkesbarre Advertiser of May 19, 1815, in one of his most prized volumes: "The driving, I have the pleasure to assure the public, will be in the best style, as I drive myself, and am always sober, yet a merry fellow on the road."

Cy Perkins, Chicago's favorite quartet baritone, reports an elegant time at Franklin Supply Company's party in the new quarters at 624 South Michigan Avenue in early February. The affair was hosted by head man Jene Harper and his vice prexy Stan Martin, aided and abetted by such local Franklinites as Ed Barta, Bob Cahill, Ray Diadul, Don Ernest, Frank Ernst Jr., Ken Goodell, Ron Keef, Al Mitchell, John Orr and Burt Strouse. From East Chicago came manager Roy Wood, Bob Brewster and Frank Dorney, and from far off Grayville came manager Leland Strouse.

These Franklin folk literally laid themselves out to see that the 250 guests were plied with liberal helpings of titivated calories and occasional beakers of singing water. The result was that a great content fell upon the multitude and they waxed exceeding glad. A coniuror mystified them terrifically and an accordionist stimulated impromptu quartets and trios to burst into their respective ideas of harmony. It was all very swell, according to Perky, but not at all surprising, because the Franklin folk just naturally do things up in good style.

Paul Andrews, the genial Signal Gas and Oiler, and his official California AIME aides, senior and junior, combined business and pleasure recently at a right enjoyable dinner gathering in the University Club, Los Angeles. Chris Christanelli, Baroid's bearer of good tidings opened the festivities by leading a community sing with his usual excellent concertina accompaniments. During the dinner, Chairman Paul introduced an imposing roster of Mid Continent and Eastern biggies, as follows: Lloyd Elkins, national chairman of AIME petroleum branch, production research director for Stanolind at Tulsa, and a dachshund fancier of note—he likes the pooch with the low wheel base because it can be housed in an old stove pipe; Dr. Donald Katz, professor of chemical engineering, University of Michigan, has only missed one Mid Continent AIME meeting since 1933, and likes color photography but says he wishes photographers wouldn't work in clicks. Tsk! Tsk!: Dr. Morris Muskat, chief of the physics division of Gulf Research in Pittsburgh, and a mathematical whiz—the boys call him the petrolic Einstein; Smiling Herb Cooley, the affable Bethlehem lad, has headquarters in Tulsa but is seen everywhere; Ev Trostel of DeGolyer & McNaughton, Dallas, ex-Angeleno, makes television sets and simple things like that when time hangs heavy on his hands. Bill Strang, exec sec of the oily AIME, Dallas, well known oil editor, likes to work in the garden until he has enough worms to go fishing: Jack Dougherty, another De and McNaughton chap, old Cal Tech boy, also gets exercise in gardening—very meticulous—won't put a double petunia in a single bed; Joe Alford, editor Petroleum Technology, Texas Tech and Stanford man, when asked why editors use blue pencil, replied, "Well, to make a long story short to make a long story short"; Lyon Terry, 2nd v.p. Chase National Bank, New York, graduate of U. of Michigan, 1915, old time oil man and consulting engineer Mid Continent, presently skipper of the good ship *Sea Fever*, as trim a craft as ever sailed across Barnegat Bay; Dr. Dorsey Hager, consulting geologist, Phoenix, Arizona, author of highly regarded geological works, popular member of AAPG, and high in the Masonic order. Following the introduction of these distinguished guests, a short business session ensued, and then Bill Geis closed the proceedings with an exciting technical address on "The Dastardly Waters of the Black Hills."

Train Company Drivers

S.S. Allen, Stanolind driver training instructor, prepares to load detonator as Sgt. W. P. McGuire of the Tulsa, Oklahoma, police looks on.

TRAFFIC would be a much smaller problem in the nation if all motorists could take the training course given Stanolind Oil and Gas Company drivers at Tulsa, Oklahoma.

For through the two-hour course more than 2000 Stanolind drivers have learned about their own limitations in operating cars and trucks. They've also had a good review of traffic regulations.

Stanolind installed the course in an effort to cut its motor vehicle accident rate, which is already one of the lowest in the oil industry. Over 1800 company drivers in 11 states have completed the training. The last several hundred are general office employees who are now being given the course.

During the two hours of testing, each driver takes vision tests and reaction time checks. He also goes through an actual driving run with a competent instructor. Thus he is made more conscious of his own driving habits and his ability to control a moving vehicle.

Just how long it takes to stop a moving car is illustrated dramatically through use of the detonator. This is a device which is loaded with two .22 caliber blank cartridges. One is fired by the instructor as a signal to the driver to stop; the second fires automatically when the car's braking action begins. Each cartridge shoots a piece of chalk to the pavement, marking the spot where it was fired.

The distance between the chalk marks shows how long it took the driver to get his foot off the accelerator and on to the brake. The actual braking distance is measured from the second chalk mark to the front of the car. On the average, it takes 42 ft to stop a car travelling 20 miles an hour. But most drivers find it hard to believe the car moved that far before stopping.

Typical remarks heard after the test range from "I didn't realize the car would travel that far!" to "I don't believe it. Let me try it again." Sometimes drivers repeat the test several times before they are convinced.

Simple mechanical devices are used in testing the driver's vision. The first measures his field of vision—the overall area he can see while looking straight ahead. Seated at the device the driver looks straight ahead while white pegs are moved forward along the sides of the instrument. As soon as he sees the pegs moving, they are stopped and his field of vision is noted.

The second device checks visual acuity, or sharpness of vision with respect to picking out details. The trainee looks into a mirror and reads from charts reflected in it.

The depth perception (distance judgment) test requires the trainee to look into a mirror and line up three toy automobiles on moving tracks. The test is similar to that given pilots.

A fourth device clocks a driver's reaction time. He sits before a mock-up automobile floorboard with his foot on the accelerator. When a red light flashes, he applies the "brakes" as fast as possible. His reaction time is measured in hundredths of a second.

Stanolind's driver training program is said to be the first of its kind in the oil producing industry. It was developed in cooperation with the Automobile Club of Oklahoma and the Oklahoma Highway Patrol. It was begun in January when 18 company men were brought to Tulsa to take a 30-hr training course under Trooper O. B. Patterson of the Patrol. The 18 men became company instructors and have handled the training of the 2000 drivers. Instructing the course is S. S. Allen of Oklahoma City.

The company has established permanent driver training committees in each of its four divisions. The course will be given to all new employes who drive company cars and trucks. Instructors will also do further work with employes who demonstrated poor driving habits in the first tests. * * *

Officers measuring distance between chalk marks following detonator test.

Quick and easy operation means less wear. Less wear means less maintenance! ● Take a look at the heavy I-beam wedge. Precision machined slots along each side of the wedge fit closely to the sturdy guide ribs that are integrated with the valve body, reducing vibration, assuring perfect seating. ● The rugged T-slot on top of the wedge permits a fine adjustment of the wedge to the seats, provides a positive, leakproof closure. ● The carefully machined flange, the extra body-wall thickness, the heavier construction throughout the entire design give OIC Valves the extra stamina to withstand fluctuating pressures and tough service. ● Features like these make OIC Valves operate so smooth and easy, last longer, save time, save *money!* Features like these are why OIC *Sets the Pace in Valves!*

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You'll find it full of valve specifications and application data — facts that you'll want to know. Ask your distributor today, or drop a line giving us your name, address and firm. The Ohio Injector Company, Wadsworth, Ohio.

OIC VALVES
STEEL · IRON · BRONZE

NEWS

Caltex in Italy

Agreements have recently been concluded between Caltex and the Fiat Company of Turin, whereby Caltex has purchased an interest in Petrolea S. A., a company owned by Fiat and engaged in marketing petroleum products in Italy. The new name for this marketing company will be Petrolcaltex.

Caltex and Fiat also plan to construct a refinery in the Po Valley, with an initial capacity of 10,000 bbl per calendar day. The operating company, already organized and known as SARPOM (Societa per Azioni Raffineria Padana Olii Minerali), will process Arabian crude supplied by a pipe line connected to a coastal terminal located at Savona, in the vicinity of Genoa. The refined products will be marketed primarily throughout the industrial centers of northern Italy.

Caltex investments in SARPOM and Petrolcaltex are an integral part of a general program of expansion of activities in Europe and the Mediterranean area.

WAA Blast Furnace

A new, 5-year agreement between Kaiser-Frazer Corporation, Willow Run, Michigan, and Republic Steel Corporation, Cleveland, Ohio, for continued operation of the government-owned blast furnace in Cleveland (known as Plancor 257) was recently approved by War Assets Administrator Jess Larson.

Larson said the new agreement assures an uninterrupted supply of pig iron to small foundries in the North now being served by Republic. It also provides for an expansion of facilities to increase steel production capacity.

Western Canada Demand Will Soon Be Met Locally—Pogue

A favorable forecast concerning the future development of oil production in Canada was made February 24 by Joseph E. Pogue, vice president of the Chase National Bank of the City of New York, speaking before the Investment Dealers' Association of Canada at Toronto.

"Nearly every important Canadian and United States oil company is active in Western Canada with the cream of its technical personnel," Pogue said. "Over 50 million acres of leases have been taken up, 60 geophysical crews are at work, over 40 wildcat wells are being drilled hopefully, and production has reached 40,000 bbl per day.

"The size and availability of the market is a limiting factor in the rate of production," Pogue declared. "The local market—Alberta, Saskatchewan, and Manitoba—which represents a consumption of about 60,000 bbl per day, will be saturated in a year." Much of Canada's rising oil production must be placed in the world markets because the large Canadian market in the East cannot be reached physically by western oil as economically as oil from the United States and the Caribbean.

Pogue estimated that it would require an investment of about a billion dollars to increase Canadian production from 40,000 bbl to 400,000 bbl daily (the predicted consumption rate 10 years hence). He stated further that it seemed probable to anticipate the discovery of 5 to 10 trillion cu ft of natural gas if 2 to 3 billion bbl of oil are discovered in the next 10 years, thus raising the question of gas transmission lines.

Atomic Power Plants in Near Future

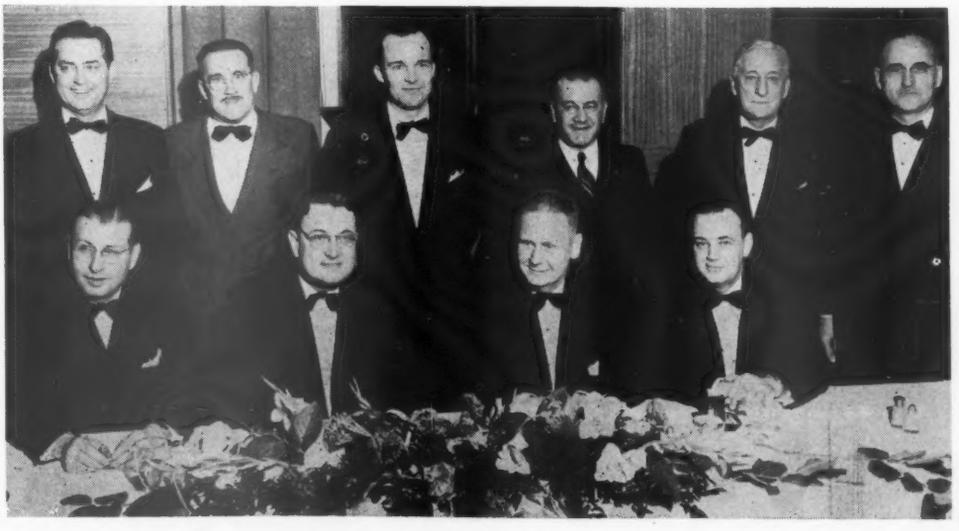
Future atomic power plants are likely to be of two kinds, according to Richard G. Lorraine, of the General Electric Company's Central Station Engineering Divisions.

Speaking before the Buffalo, New York, Chapter of the American Society of Mechanical Engineers, he said that one might expect large primary plants, producing great quantities of power as well as synthetic fuel. Such fuel could then be used in smaller secondary plants for the production of heat and power only. Some of these might be mobile units for propulsion power.

While the primary plants most likely would be government financed and operated, he added, the secondary plants could be under private control, though national security would have a large bearing on such operations and the extent of government regulation.

However, such development depends on the success of scientists and engineers in constructing "breeding" reactors as sources of atomic energy. These would not only "burn" one kind of uranium in the energy-yielding fission process, but would also convert another kind, and even another element, into new atomic fuel. He said that theoretically it seems likely that this can be achieved, and that a breeding reactor can actually produce more secondary fuel than the primary fuel it uses.

It is expected, he stated, that one or two small capacity atomic power plants will be in operation within three or four years, but at least 20 years and probably much more will be required before really large amounts of power are so generated.



OFFICERS OF TULSA NOMADS. Seated, Mitchell Tucker, Oil and Gas Journal, treasurer; Kenneth O. Hoevel, National Supply, president; H. M. Cooley, Bethlehem Steel, vice president; George Davidson, W. C. Norris, Manufacturer, secretary. Standing, Amos A. Roberts, Baroid Sales, National Lead, assistant treasurer; Opie Dimmick, Century Geophysical, sergeant at arms; Clair Nabors, Reed Roller Bit, assistant secretary; Anthony Gibbon, World Oil, regent; H. M. Cosgrove, Mid-Continent Purchaser, executive secretary, national board of regents; M. D. Gilbert, Rockwell Manufacturing Company, regent, who was president last year.

"Biggest Inch" Blythe St

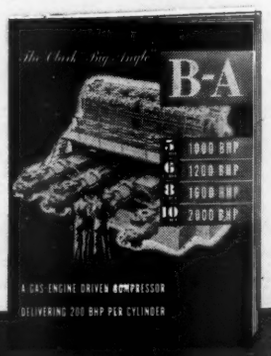
... on Texas-California Pipeline ...

The new Blythe booster station of the Southern California Gas Co. and the Southern Counties Gas Co. is the California link in the big pipe line from the Texas fields to the Los Angeles area. Blythe receives the gas from the El Paso Natural Gas Company, whose nearest booster station is at Gila Bend, Arizona, 140 miles east.

Activation of this new station increases the flow of Texas gas from 175 MMcf per day to the full designed capacity of the station of 305 MMcf per day. That means energy equivalent to the output of six Boulder Dams carried through the largest diameter, high-pressure gas transmission line ever built.

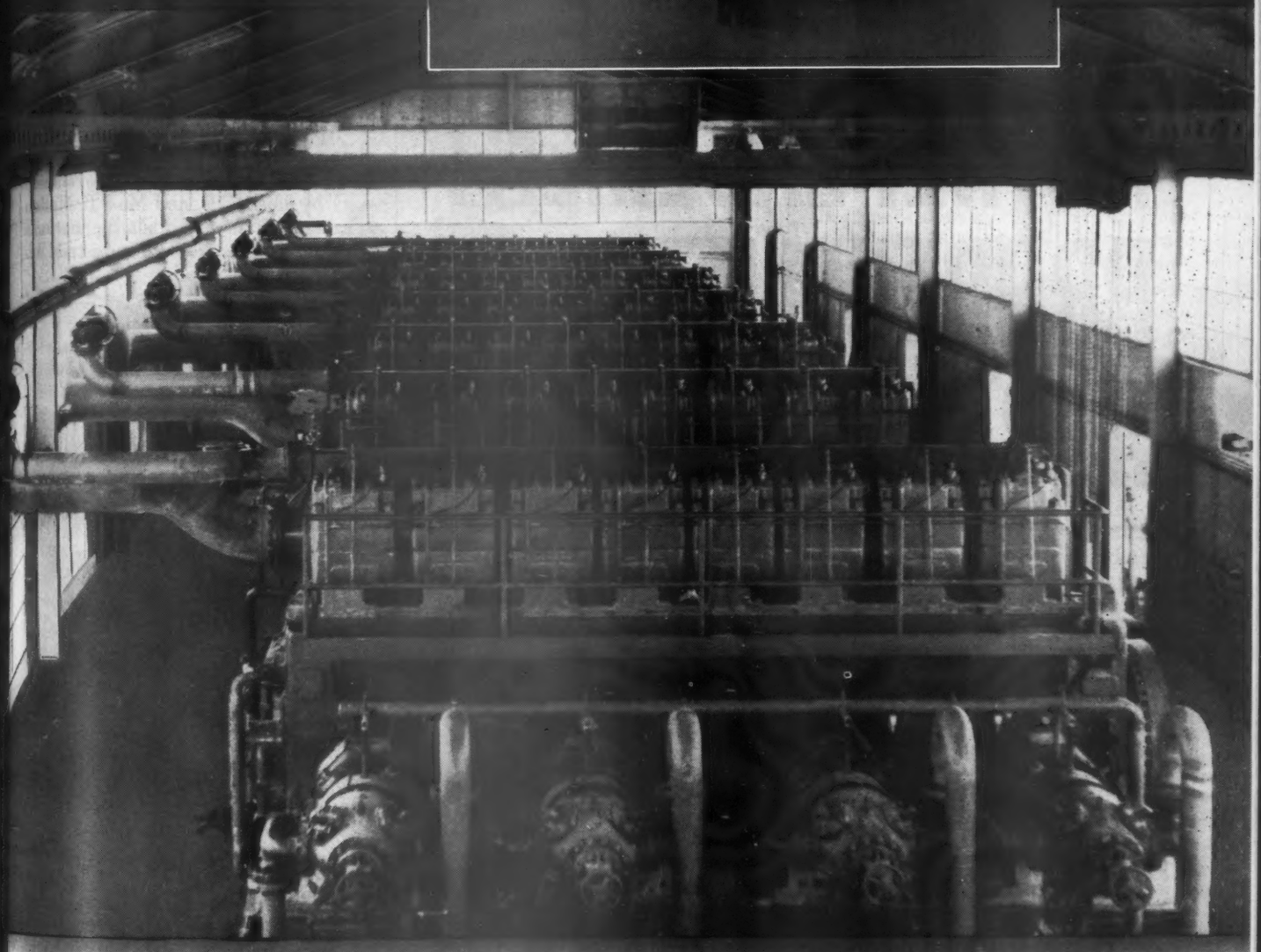
The Clark "Big Angle" installation consists of seven 8-cylinder, 1600 BHP compressor units with a total of 11,200 BHP. The compressors operate with a suction pressure of 350 to 500 psi and a discharge pressure of 680 to 800 psi.

Write for new bulletin on the Clark "Big Angle". It contains detailed information, dimensional drawings and other useful data.



CLARK "BIG ANGLE" COMPRESSORS

ne Station



11,200 BHP of Clark "Big Angles" in booster station at Blythe, Calif. (At top) view of 8-cylinder, 1600 BHP Clark Compressor like those in Blythe Station. In addition to being the most compact heavy-duty, gas-engine-driven compressor unit ever built, the Clark "Big Angle" is the most accessible. It saves money in both installation costs and maintenance.

CLARK BROS. CO., INC. • OLEAN, NEW YORK

One of the Dresser Industries

BIRMINGHAM, ALABAMA, BOSTON, CHICAGO, DETROIT, HOUSTON,
LOS ANGELES, NEW YORK, SALT LAKE CITY, SAN FRANCISCO, TULSA, WASHINGTON, LONDON, PARIS,
BUCHAREST, RUMANIA, CARACAS, VENEZUELA, BUENOS AIRES, ARGENTINA

Dual Fuel Engines

"A substantial percentage of the diesel engines produced in America over the next several years will be of the dual fuel or gas-diesel type." This prediction was made by Ralph L. Boyer, vice president and chief engineer of the Cooper-Bessemer Corporation. Several cost saving benefits will largely account for this growing preference for diesel engines that can be operated either on gas, on oil, or on any combination of gas and oil, as may be determined by the supply and cost of either fuel.

The dual fuel engine is a highly efficient power plant by all known standards today. Its 40 per cent brake thermal efficiency (at full load, supercharged) produces a brake horsepower hour at no more than 6400 Btu. The average automobile engine approaches only 25 per cent thermal efficiency under ideal operating conditions.

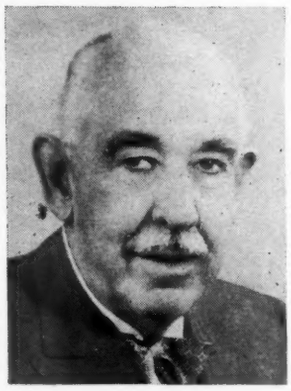
Boyer cited oil field drilling as an example. If gas is available its cost may be considered negligible; however, gas is frequently not available, particularly in wildcatting, and drillers must start out with straight oil diesel operation. Since at remote wildcatting sites 14 cent oil is not uncommon, for each 1000 hp the driller will save $60,000 per year, based, of course, on that many horsepower hours being developed during the year.

More Employe Benefits

A $70,000,000 group life insurance plan, one of the largest ever written in the West, will cover eligible employes of Standard Oil Company of California and certain of its domestic subsidiaries, it was announced by T. S. Petersen, Standard's president.

Mellon Gift

Approximately six million dollars in cash and securities has been given to the Carnegie Institute of Technology by The W. L. and May T. Mellon Foundation to establish the nation's first graduate school of industrial administration, Carnegie President Robert E. Doherty has announced. The new School will offer a three-year program including one year of graduate work leading to a Master of Science in Industrial Administration.



William Larimer Mellon

Dr. Doherty said the school would differ from both schools of business administration and those of engineering. The program to be offered will combine fundamental training in basic science and engineering with that in economics and management. "In short," Dr. Doherty said, "the new School will aim to produce men who have the fundamental qualifications for professional growth in the field of industrial administration and who will be active, intelligent citizens."

William Larimer Mellon, nephew of the late Andrew W. Mellon, was one of the founders of the Gulf Oil Corporation and its active head for the past 46 years, retiring in 1948 as Chairman of the Board. He has been a trustee of Carnegie Tech 12 years.

NO REPLACEMENT PROBLEM HERE...

with TRANSITE PIPE on the job in this Salt Water Disposal Line

HERE IS ANOTHER Transite* salt water disposal line that will soon be saving money. Frequent pipe replacements will be eliminated because Transite Pipe, made of asbestos and cement combined by a special process, fights corrosion two ways. It resists the corrosive action of salt water on the *inside*... corrosive soil on the *outside*.

You get other advantages, too, with Transite Pipe. Light in weight, it is easy to handle. Most sizes can be unloaded and lowered into the trench without the use of mechanical handling equipment. And Transite's factory-made Simplex Couplings speed assembly ... provide *tight* yet *flexible* joints that permit laying the pipe around curves without special fittings.

For further details, address Johns-Manville, Box 290, New York 16, N. Y.

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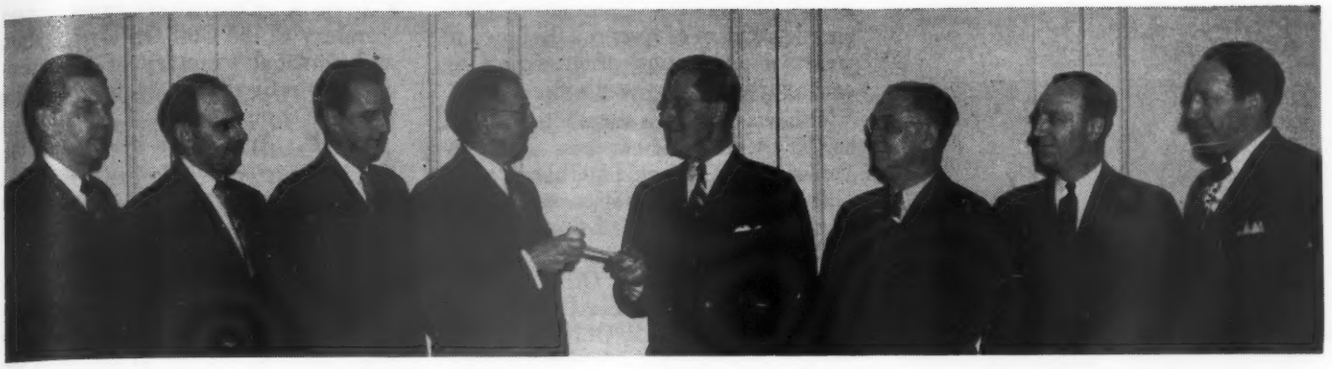


New York Nomads' 1949 officers are: Secretary R. V. McIntire, Assistant Treasurer M. F. Delano, Treasurer C. P. MacDonald, Jr., out-going President (elected as regent) Val R. Wittich, Jr., President James W. Reed, Vice President W. D. Robinson, Assistant Sergeant-at-Arms K. D. Demarest, Assistant Secretary E. T. Landgraff. Elected officers not present when the photograph was taken were Sergeant-at-Arms Marvin D. Rasher and Regent A. V. Simonson.

Sells Asphalt Business

Barber Oil Corporation has sold its asphalt business, including its lease of the Pitch Lake on the Island of Trinidad, to the Previte interests of London, it has been announced by T. Rieber, president of Barber.

For the past sixty years, the Previte family has been associated with Barber in marketing Pitch Lake products in England and on the continent. Under the terms of the sale, Barber will keep its oil storage and terminal facilities at Brighton, Trinidad, and its royalty interests in nearby properties.

Texas Safety Conference

Petroleum and related industries won a lion's share of awards in the Texas Safety Association's annual Industrial Safety Contest. Charles A. Miller, president of the association, presented the certificates of recognition at a banquet on the opening day of the annual Texas Safety Conference, held in Houston, March 9-10.

Of 69 awards in petroleum industries, Phillips Petroleum Company took 22. The Gulf companies won 16. Other winners were: The Texas Company, 2; Humble Oil and Refining Company, 2; Sun Oil Company, 1; Shell Oil Company, 12; Stanolind Oil and Gas Company, 5; Magnolia Petroleum Company, 3; United Gas Pipe Line Company, 2; Atlantic Pipe Line Company, 1; Geophysical Service, Inc., 1; Hughes Tool Company, 1; and Sperry Sun Well Surveying Company, 1.

Law Institutes

The Southwestern Legal Foundation has announced the First Annual Institute on Oil and Gas Law and Taxation to be held at Southern Methodist University, Dallas, Texas, March 23-26. On April 1 and 2 an Institute on Labor Law will be held.

Engineers' Day

All branches of engineering will be represented at the fifteenth annual Engineers' Day of the Colorado School of Mines in Golden April 22 and 23, 1949. The event will include technical sessions in mining, metallurgy, petroleum production, petroleum refining, geophysics, and geology, as well as exhibits from companies engaged in the mineral industries.

Shell Photo Exhibit

A photo exhibit which tells the story of oil industry operations from the discovery of crude oil to the marketing of finished products has been prepared by Shell Oil Company for display in its various field offices and plants. The exhibit is designed to give employes in each department a glimpse of activity in the others so as to broaden their understanding of the industry in which they work.

Including approximately 150 pictures in all, the exhibit consists of five divisions—Exploration, Production, Manufacturing, Transportation, and Marketing—which correspond to the major phases of the oil industry. Each group of pictures is headed by a short explanatory text block, and a brief caption appears under each photograph.

Operations in Saudi Arabia

Crude oil production in Saudi Arabia during January amounted to 16,240,352 bbl, or an average of 523,882 bbl per calendar day, it has been announced by the Arabian American Oil Company. The production for 1948 was 142,852,989 bbl, averaging 390,309 bbl per day.

Crude processed at the Ras Tanura refinery amounted to 3,504,056 bbl, or an average of 113,034 bbl per calendar day. The daily average runs in 1948 amounted to 123,186 bbl.

API Publishes Papers On Analyses

Publication by the American Petroleum Institute of the war-restricted papers on "Newer Physical Methods of Analyses" presented at a Symposium on May 12, 1944, before the Technical Advisory Committee of the Petroleum War Council is announced by that association, obtainable from J. A. McNally, API, 50 West 50th Street, New York 20, at a price of $3.50 per copy. Only 1000 copies have been printed.

These methods are published to make them a part of the chemical and physical literature of the industry, it is stated. They include papers on Freezing-Point Measurements, Adsorption and Refractometry, Analytical Distillation, Raman Spectra, Ultraviolet and Infrared Absorptions, the Mass-Spectrometer and Applicability of Newer Physical Methods for Hydrocarbon Analysis.

Atlantic Pension Increases

The Atlantic Refining Company has announced adoption of a plan to make supplemental payments for a temporary period to employes who left active service in the company prior to January 1, 1949, and who now receive retirement allowances. The extra payments, which are an offset to increased living costs, will range from 5 per cent to 40 per cent of current retirement allowances, depending upon the date of retirement. The entire cost will be borne by the company.

Diamond Chain Distributor

Chase, Parker and Company, Inc., 288-290 Congress Street, Boston, have been appointed distributors for the Boston area by Diamond Chain Company, Inc., of Indianapolis, makers of roller chains, sprockets, flexible couplings, and conveyor chains.

PERSONALS

Lloyd Lynd

G. R. Preston

▸ **Lloyd Lynd** of Bartlesville has been elected a vice president of Cities Service Oil Company (Delaware), according to an announcement by A. W. Ambrose, president. Lynd is at present also treasurer and director of Cities Service Oil Company, Empire Pipeline Company, Cities Production Corporation, and Terminal Facilities, Inc., and a director and assistant treasurer of Cities Service Oil Company, Ltd.

He was employed by Cities Service Oil Company as a junior engineer in 1919, upon his return from service in World War I. After completing the junior engineer course, he was assigned to various departments of the treasurer's division until May of 1928, when he was elected assistant treasurer of Cities Service Oil Company. Elevation to the post of treasurer came in August of 1941.

▸ **G. R. Preston** has been named manager of Cities Service economics department. He will continue to head the company's program for acquiring producing properties. Preston has been with Cities Service for 24 years.

▸ **R. W. (Pat) Murphey** has been designated advertising manager of Taylor Forge and Pipe Works, whose general offices and main plant are in Chicago. The company also operates an Eastern plant at Carnegie, Pennsylvania, and a western plant at Fontana, California. Murphey has had extensive industrial advertising experience, and is well known in the Chicago area.

▸ **C. N. Pfhol, Jr.,** of Bradford, Pennsylvania, has been appointed a member of the production research advisory committee of the Pennsylvania Grade Crude Oil Association, according to announcement by D. T. Ring of Columbus, Ohio, Association president. Pfhol is head of Kendall Refining Company's crude oil production department.

G. W. Holbrook of Bradley Producing Corporation, Wellsville, New York, is chairman of the committee, which steers the Association-sponsored program of research designed to improve production of crude oil by secondary recovery methods.

Other committee members include D. T. Andrus of Andrus and McDowell, E. T. Heck of Quaker State Oil Refining Corporation and A. J. Saxe of South Penn Oil Company, all of Bradford; R. B. Bossler of Brundred Oil Corporation, Oil City, and P. N. Faine of the Ohio Oil and Gas Association, Newark, Ohio.

▸ **Walter A. Jayme** has been promoted to general superintendent of the Gary Works of National Tube Company, a U. S. Steel subsidiary. He has been assistant general superintendent of the plant since 1947 and has been associated with U. S. Steel subsidiaries for 14 years. Four years ago he was made director of research and development of the National Tube Company's war rocket project at National Works, McKeesport. He served as assistant to general superintendent of the tube company's plant in Ellwood City, Pennsylvania, before transferring to Gary.

▸ **Orlo W. Bond,** manager of the New Delhi branch office of Standard-Vacuum Oil Company's India division, has retired.

First employed in 1922, Bond went to India that year. After three years as field manager on the Malabar Coast and six years as a marketing executive in Madras, he went to Karachi where he became operations manager. In this key position during the war. he supervised delivery of petroleum products to the China-Burma-India theatre and worked with the petroleum offices of the Air Transport Command and the U. S. Navy.

▸ **Foster Jordan and John Gates** have been named division managers of Well Equipment Manufacturing Corporation's northern and southern sales division. Jordan, with headquarters in Dallas, will supervise activities of WECO representatives in Inland Texas, New Mexico, North Louisiana, Oklahoma, Arkansas, and Kansas. Gates, as southern division manager, will continue to have headquarters in Houston and will be responsible for activities in Southwest Texas, Texas Gulf Coast, South Louisiana, Mississippi, and Florida.

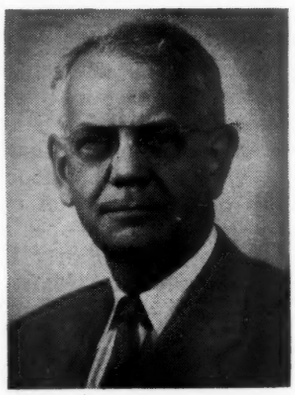
Gordon M. Amstutz has joined U. S. Steel's Oil Well Supply Company as chief industrial engineer, according to an anouncement by Fred E. Link, general works manager, at the company's Dallas, Texas, headquarters. Amstutz will be located at Oil City, Pennsylvania.

▸ **Jesse K. Crownover,** an assistant secretary of the Gulf Oil Corporation and personal secretary of the president has retired after 41 years service with the company.

H. P. Arbuckle has been appointed general auditor in charge of accounting and auditing for both domestic and foreign refineries and **H. D. Taylor** becomes assistant general auditor of accounting and auditing for both domestic and foreign refineries. J. W. Nichols has been named chief internal auditor of the sales department. All three men are veterans in the Gulf service and will be in its general offices at Pittsburgh.

▸ **Harmon Blok,** of the Royal Dutch Shell Company, Delft, Holland, will be one of the twenty speakers to appear on the three day program of the 4th Annual Convention of the American Society of Lubrication Engineers, April 11-13, at the Statler Hotel, New York. Dr. Blok, who is journeying from Holland especially for this appearance, will speak on "Hydrodynamic Lubrication."

▸ **George F. Prussing,** one of the petroleum industry's best informed safety engineers, announces the opening of offices at Room 1001, Petroleum Building, Los Angeles, where he will be available for consultation on all phases of fire prevention engineering,



George F. Prussing

including fire protection; the investigation of fires and explosions; preparation of technical evidence for suits involving fires; and the drafting of safety regulations and ordinances.

Prussing was responsible for the organization of Union Oil Company's safety activities, which he directed for many years. He left Union early in 1941 for a special security assignment with the U. S. Navy, later receiving high commendation for his work as director of construction on the huge war program of 100-octane plant installation in California. For the past 4 years he has been technical secretary of Western Oil and Gas Association.

PERSONALS

▸ **C. M. Reading** has been promoted from assistant manager to manager of the engineering department, General Petroleum Corporation. Graduated from the U. S. Military Academy in 1924, he joined General Petroleum in 1926. He entered military service in February 1941 and left the service in October 1945 with the rank of Colonel.

C. G. Cortelyou has been appointed project engineer for General Petroleum. A graduate from California Institute of Technology with B.S. in mechanical engineering, he joined General Petroleum as a junior laboratory technician in 1938.

R. S. Hartman has been advanced to general superintendent of the Vernon headquarters of the transportation department.

E. E. Lempp has become assistant manager of building utilities in General Petroleum's Los Angeles home office.

▸ **Philip E. Jackson,** formerly zone sales representative for the Detroit Diesel Engine Division of General Motors Corporation in the south central states, has taken up similar duties in the division's Middle Atlantic zone. He will be responsible for all distributor and dealer sales activities pertaining to General Motors Series 71 Diesel engines. **A. W. Anderson,** northeastern zone sales representative, takes over the sales assignment in the south central territory previously covered by Jackson.

▸ **George L. Mitsch,** assistant plant manager, has been promoted to plant manager at the St. Louis foundry of the American Car and Foundry Company, according to an announcement by R. W. Ward, vice president in charge of production.

Nelson C. Walker, assistant district manager of the ACF Berwick, Pennsylvania, plant, has been promoted to district manager of this plant, relieving **Justus W. Lehr,** who has been granted an extended leave of absence. During Walker's service with U. S. Time Corporation, he aided in the design and headed up manufacturing of precision instruments for the central fire control system on B-29 Superfortresses. Following the close of World War II, he became chief engineer and assistant to the vice president of manufacturing of the Noma Electric Corporation. Subsequently, he became president of the United Tank Corporation, which post he held prior to coming to ACF.

▸ **Tom Austin,** recently appointed sales engineer for Aeroquip Sales and Engineering, Inc., of Fort Worth, Texas, represents the company in Missouri, Kansas, Nebraska, and Colorado. His headquarters are in the Land Bank Building, Kansas City, Missouri. Before coming with Aeroquip, Austin was associated with the Power Transmission Company of Dallas.

▸ **Russell J. Cooper** has been appointed assistant manager of The Texas Company's personnel department, it was announced. He joined Texaco in 1917 as an accounting clerk, and has handled various industrial relations assignments for the company since 1942 except for a period during World War II when he was executive assistant to the Industry members of the National War Labor Board.

▸ **James K. Ellis,** vice president in charge of production for Sunray Oil Corporation, was named a member of the company's board of directors at a meeting of the board in February. Ellis has been associated with Sunray since 1946 when he became an officer of the company at the time Transwestern Oil Company was merged with Sunray. He had been with the Transwestern organization since January 1937.

Sunray's current directorate includes: F. B. Parriott, chairman of the board; C. H. Wright, president; F. L. Martin, executive vice president; Vice Presidents Edward Howell, Paul E. Taliaferro and Ellis; W. D. Forster, secretary; Thomas W. Bowers; Alfred L. Rose; A. A. Seeligson; Glenn J. Smith; and Charles F. Urschel.

▸ **Herman C. Phelps** has been made sales manager of All-State Welding Alloys Company, Inc., White Plains, New York, Bert Laune, president, announced.

Phelps, formerly All-State's West Coast regional sales manager, operating out of Seattle, Washington, has moved to White Plains, and assumed national duties in connection with sales and service for the entire line of All-State low-temperature welding and brazing alloys and fluxes.

▸ **Stanwood W. Sparrow** has been elected president of the Society of Automotive Engineers, for 1949.

Sparrow is vice president in charge of engineering of Studebaker Corporation, South Bend, Indiana. His engineering career closely parallels the history of the automotive industry since his graduation from Worcester Polytechnic Institute in 1911.

He was born in Middleborough, Massachusetts, in 1888.

B. W. Letcher

▸ **B. W. Letcher's** election to the board of directors of Standard Oil Company of California has been announced by H. D. Collier, board chairman. Letcher has been with Standard since 1911, when he went to work as a clerk in the manufacturing department. He later became chief clerk in the general office, then assistant general auditor and in 1926 was made general auditor. Letcher was elected secretary and comptroller in 1940 and a vice president in 1944. Recently, he has devoted most of his time to Standard's foreign interests.

▸ **Paul F. Marx** has been appointed corrosion engineer for Dresser Manufacturing Division, Bradford, Pennsylvania, where intensive research has been instituted on corrosion problems affecting gas, oil, water, and other types of piping. Marx was one of the first members of the National Association of Corrosion Engineers. Since 1930, when he inaugurated the corrosion development for the Natural Gas Pipeline Company of America, he has been continuously concerned with corrosion problems.

▸ **Benjamin W. Bourne,** sales engineer with Black, Sivalls and Bryson, Inc., has been transferred to the Midland, Texas, sales office. He was formerly in charge of the company's sales office at New Orleans, Louisiana. **C. W. Hayes,** company engineer at Kansas City, Missouri, has taken temporary charge of the sales office in New Orleans.

Raymond D. Canada, who has recently transfered from the Kilgore, Texas, branch, will be in charge of the company's new sales office at Magnolia, Arkansas.

Floyd C. Myers, regional sales manager for Black, Sivalls and Bryson, Inc. has transferred headquarters from the company's branch at Lubbock to Midland, Texas.

John T. Cross, Jr. has been appointed branch manager for the company at Hobbs, New Mexico.

▸ **George W. Wells,** comptroller for the Superior Engine Division of The National Supply Company, Springfield, Ohio, died January 16, in his 66th year. Wells had been associated with National Supply for 45 years—from 1903 to 1936 at the company's Toledo, Ohio, plant, and from 1936 to 1944 at the company's executive offices in Pittsburgh, Pennsylvania, before being transferred to Springfield.

▸ **Clyde B. Lynde** has been appointed vice president and general manager of the insulation division of The Eagle-Picher Sales Company at Cincinnati. He has had many years experience in virtually all phases of the insulation business, including both home and industrial insulation. He was active during the war in the construction of several of the largest high-octane gasoline refineries, synthetic rubber plants, and chemical process plants in the Southwest.

▸ **Jack A. Collins** has been appointed administrator of purchases, production department, Sun Oil Company. He will coordinate the purchasing activities of Sun's production offices in Dallas and Beaumont, Texas; Tulsa, Oklahoma; Evansville, Illinois; and Toledo, Ohio. His office will be in the First National Bank Building, Dallas.

▸ **H. S. Dershimer** has joined Macwhyte Company, manufacturers of wire rope. As direct factory representative for the company, he will have headquarters in Tulsa, Oklahoma, and will travel in Oklahoma and parts of Arkansas, Kansas, and Wyoming, a territory in which he has worked the past twelve years.

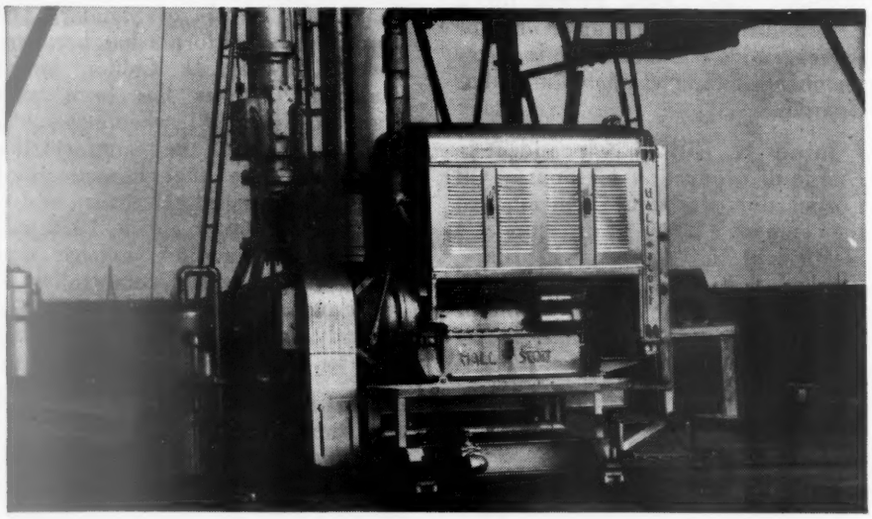
H. S. Dershimer

▸ **Edward W. Beltz,** a petroleum geologist with 30 years experience in many parts of the world, retired from Standard-Vacuum Oil Company January 1 to begin a new assignment with Arctic Contractors, Inc., engaged in developing the U. S. Navy Petroleum Reserve No. 4 at Point Barrow, Alaska.

Formerly head of Standard-Vacuum's geological operations in the East Indies, Beltz is a veteran oil searcher. His career began in 1918 in the Yukon with the Canadian Geological Survey. In the ensuing ten years he surveyed potential petroleum areas in Alberta, Macedonia, Thrace, Trinidad, Madagascar, and the southern half of the African continent.

Assigned to Sumatra in 1929, Beltz participated in the early development of the Talang Akar-Pendopo oil fields. In 1935 he explored petroleum possibilities for Standard-Vacuum in the Philippines. Returning to Sumatra, he remained there as chief geologist until the outbreak of war. He returned to the United States in April, 1942, to join Standard-Vacuum's New York headquarters staff. Since the war, he has made several trips to China to survey oil possibilities in Kansu province.

▸ **Joe B. Alford,** of Dallas, Texas, has joined the staff of the Petroleum Branch, American Institute of Mining and Metallurgical Engineers. Alford will serve as assistant executive secretary for the Branch and will be editor of the *Journal of Petroleum Technology*. The *Journal* is a new AIME monthly magazine which will be published in Dallas for international circulation.



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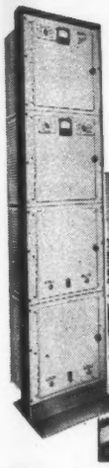
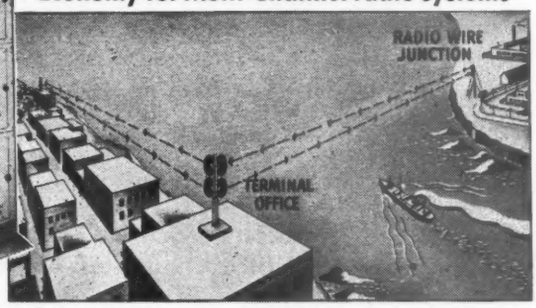
RADIO LINK SYSTEMS up to 23 Voice Channels



Intelink* FTR 11-A-1

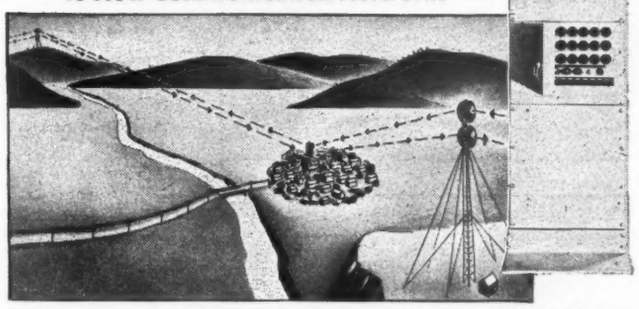
UHF Broad Band FM
Sets New Standards of Flexibility and Economy for Multi-Channel radio systems



When used with suitable carrier telephone or telegraph equipment, the FTR 11-A-1, with a bandwidth of 60 KC, provides a complete multi-channel communication system—or an intermediate link for both cable and open wire systems. It's the economical way to span mountainous, swampy and soft terrain—and to hurdle cities, rivers, lakes, bays and inlets.

Intelink* FTR 1001-A

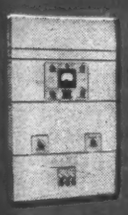
Multiplex Pulse Time Modulation Points the Way to New Communication Networks



Utilizes the principle of Pulse Time Modulation. Up to 23 telephone channels—or a combination of telephone and telegraph channels. This system is suitable for ranges of more than 1000 miles with repeater stations at points of line of sight. This system can be readily integrated with existing wire systems and will provide all necessary ringing and dialing facilities.

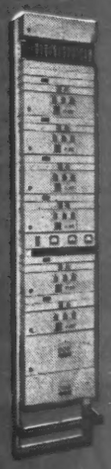
*Trade Mark

TELEGRAPH CARRIER SYSTEMS



Speech-Plus-Duplex Telegraph Carrier
FTR 9-C-1

Gives duplex tele-printer channel over any speech circuit (two over a carrier telephone or radio channel) retaining speech facilities. Up to 100 words per minute. Distortion minimized by Frequency Modulation.



Multi-Channel Carrier AM or FM
FTR 9-E-1

Provides from 1 to 18 voice-frequency telegraph channels—up to 100 words a minute—over a single telephone circuit.

TOLL TESTBOARD

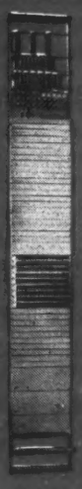
FTR 9-G-1

A toll testboard for rapid location of faults in telephone lines via a Wheatstone bridge or a precision voltmeter calibrated directly in megohms. Designed for bay mounting on standard 19-inch relay rack.

REPEATER

FTR 9-D-1

This flexible arrangement of amplifiers and other components is designed for multiple applications of 2-wire and 4-wire telephone repeaters.



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20,000' to 80,000' Each Size in Stock

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Prime Stock—T & C or Plain End
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and Venturi devices for creating vacuums, etc. Top performance against high heads. No expensive, complicated mechanism necessary. Custom built to solve your specific problem. Will mix all fluids accurately. *Excellent Navy rating.* Aladdin Proportioning Equipment Co., 119 West 57th Street, New York 19, New York.

FOR SALE

DIESELS and PUMPS

Three new unused 475 BHP 5-cylinder Baldwin Model VG Diesel Engines, one connected to Ingersoll-Rand Multi-stage Centrifugal Pump with Farrel-Birmingham Step-up Gear and two connected to Worthington Horizontal Triplex Double Acting Pumps, all units complete with Falk Couplings, Lummus Coolers, other accessories. Location Ohio, immediate shipment. Direct inquiries to The Buckeye Pipe Line Company, Joseph Steele, Purchasing Agent, Room 2200, 30 Broad Street, New York 4, N. Y.

Pacific Pump's 25th Birthday. Executives of Dresser Industries and Pacific Pumps, Inc., touring the Huntington Park, California plant on the occasion are: Arthur R. Weis, Pacific president; William A. McAfee, of Dresser's executive committee; John B. O'Connor, executive vice president of Dresser; Elmer J. Weis, Pacific vice president; Prescott S. Bush, of Dresser's executive committee; Neil H. Mallon, president of Dresser.

Petroleum Industry Census

Walter S. Hallanan, chairman of the National Petroleum Council, has appointed a committee headed by H. S. M. Burns, Shell Oil Company, to study advisability of conducting a petroleum industry census in 1950, covering 1949.

Congress has passed a new law establishing the censuses on a 5-year basis but in the last session failed to appropriate funds for mineral industries. The proposed canvass would be conducted jointly by the Bureau of the Census and the Bureau of Mines.

Brown Instrument School

Industrial instrument maintenance and repair courses which have been conducted for the past 15 years by Brown Instruments Division of Minneapolis-Honeywell Regulator Company will be divided during the first six months this year into four classes of five weeks each, and longer courses for company personnel.

Midwest Names Agent

The Summers Hardware and Supply Company, Johnson City, Tennessee, has been named northeast Tennessee distributor of the entire line of welding fittings and forged flanges of the Midwest Piping and Supply Company, St. Louis, it was announced by A. G. Stoughton, Midwest president. As distributor, the Summers company will serve the natural gas pipe line, petroleum refining, and other industries in an extended area, including Johnson City, Elizabethton and Kingsport, Tennessee, and Bristol, Virginia.

The Summers company will maintain stocks of Midwest's line of fittings, which range from 3/4 in. to 24 in. in diam, including elbows, reducers, return bends, caps, tees, etc. Welding fittings and forged flanges are of carbon steel, wrought iron, stainless steel and other metals.

The Summers company also distributes National Tube Company pipe and Lunkenheimer valves. F. L. Wallace is president of the industrial supply firm, which was founded in 1896. William B. Johnson is manager of the supply department.

Socony-Vacuum Liberalizes Military Leave-of-Absence

New and much-liberalized provisions of the company's military-leave-of-absence policy have been put into effect recently by Socony-Vacuum Oil Company to govern relations with its employes called into the service of the U. S. military organizations. For the first 30 days of service employes will continue to receive their regular salaries or wages with government pay deductions and other items required by law. For additional service employes' dependents will receive 50 per cent of the regular wages or salaries. Employes belonging to the company's annuity and insurance plans will be covered for the 30-day initial period, with regular deductions; for additional service time life group insurance will be continued but accidental death and total disability coverage will be discontinued until employe returns to company service. After the 30-day period annuity coverage will be suspended without further employe purchase and the company will buy the annuities until the employe's return to company service. Seniority and reinstatement rights are protected.

Electrical Group to Meet

The 21st Annual Convention of the Petroleum Industry Electrical Association-Petroleum Electrical Supply Association will be held at the Mayo Hotel, Tulsa, Oklahoma, April 26-27-28. V. J. Sittel, senior electrical engineer, Stanolind Pipe Line Company, is general chairman.

BARCELONA
Now included in KLM's Great Oil Network...

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Now Barcelona, Venezuela joins the other great Caribbean oil centers served by KLM's famous *Royal Route from Miami.*

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		Tues., Thurs., Sat. CONSTELLATION	Tues., Thurs., Sat., Sun. DC-4
LV....	MIAMI.....	.....08:15.....	.....23:00.....
AR...	ARUBA.....	.....14:55.....	.....07:10.....
AR...	CURACAO....	.....16:20.....	.....08:35.....
AR...	MARACAIBO..	.....16:40.....	.....08:45.....
AR...	CARACAS	.....16:45.....	.....09:10.....
AR...	BARCELONA ..	.....	Wed., Sun. 11:30.....

K·L·M ROYAL DUTCH AIRLINES
1919 30TH YEAR 1949

THE WORLD'S FIRST AIRLINE TO ACHIEVE ITS 30th ANNIVERSARY

SEE YOUR LOCAL TRAVEL AGENT or KLM Royal Dutch Airlines, 572 Fifth Ave., New York, N. Y. LU 2-4000; 308 N. E. 1st Street, Miami 3-8455. Other KLM offices in Los Angeles, San Francisco, Chicago, Washington, Boston and Montreal.

Wetter Water Subject of Film

"Fire-Fighting with Wetter Water," a new 20-minute 16mm, sound movie in color by Carbide and Carbon Chemicals Corporation, is now available for showings to municipal, volunteer, and industrial firemen or groups interested in fire-fighting and fire prevention. The movie illustrates how water made wetter by the corporation's new product, "Unox" fire-fighting penetrant, knocks out fires 3 to 4 times faster than plain water.

Interested groups are invited to arrange for showings without charge by writing Carbide and Carbon Chemicals Corporation, Room 328, 30 East 42nd Street, New York 17, New York.

Western Metal Congress in April

Latest developments in overcoming corrosion, welding in the field, and refinery metals designed for extreme temperatures are written into the programs of technical sessions scheduled for the Western Metal Congress, April 11-15, in Shrine Convention Hall, Los Angeles.

Technical sessions will be held by the American Society for Metals, American Welding Society, American Foundrymen's Society, and American Institute for Mining and Metallurgical Engineers. Approximately 20 societies are cooperating in various phases of the event, including American Chemical Society, American Petroleum Institute, American Society of Tool Engineers, Pacific Coast Gas Association, and Western Oil and Gas Association.

The Western Metal Exposition runs concurrently with the Congress. The exposition features what is new or improved in metals, welding supplies and equipment, inspection and testing aids, materials handling, metal cutting, machining equipment and tools.

Gas Technology Short Course Scheduled

The fourth annual short course in Gas Technology will be held at Texas College of Arts and Industries from May 30 through June 1.

Sponsored by the Southern Gas Association, the course is expected once more to attract more than 200 engineers and industrialists from several states. Besides attending lectures and assemblies, the group will inspect industrial plants in the vicinity and visit the King Ranch.

Frank H. Dotterweich, director of the A&I engineering division, is again chairman of the administrative committee. Working with him to plan the course are Chester Young, Dallas, Lone Star Gas Company, chairman of the utilization section; D. T. MacRoberts, Shreveport, United Gas Pipe Line Company, chairman of the production and transmission section; W. B. Wood, Brownsville, Rio Grande Valley Gas Company; C. A. McKinney, Houston, United Gas Corporation; R. H. Ulrich, Birmingham, Southern Natural Gas Company; W. C. McGee, Jr., Houston, Tennessee Gas Transmission Company; George Elmer May, New Orleans, New Orleans Public Service; R. M. Hutchinson, Houston, Houston Natural Gas Corporation; W. H. Ligon, Nashville, president of the Southern Gas Association; and R. R. Suttle, Dallas, managing director of the association.

Buys Asphalt Plant in New York State

Koppers Company, Inc., has purchased the plant and equipment of the Michael E. Sweeney Corporation of Rochester, New York, a firm that manufactures asphalt pre-mixed road materials, and applies liquid asphalts used in road construction and maintenance. Michael E. Sweeney will continue as manager of the operation for Koppers.

J. N. Forker, vice president and general manager of Koppers' tar products division, said that the plant now becomes the twenty-third to be operated by that division.

WELL PURGER

For twilight flowing periods. Automatically relieves well whenever tubing pressure drops below critical point.

MECHANICAL WELL SWITCHER

Produces any flowing well on predetermined time cycles, without loss of supply gas. Also serves as reverse acting motor valve.

PRESSURE REGULATOR

As conventional pressure reducing regulator, has operating range of 1500 p.s.i. upstream, 50 p.s.i. minimum downstream, 900 p.s.i. maximum downstream.

GAS LIFT

Regulates input gas by frequency control, by tubing pressure, by casing pressure, or a combination of any two.

STOP COCK

For flowing wells where best results are obtained by intermittent production. Opens at pre-determined high pressure, closes at pre-determined low.

VERSATILITY

Keynote of the GOT-OLSCO Pressure Controller

The basic operating principle of the GOT-OLSCO Type "A" Pressure Controller is simple and accurate . . . and so flexible in design that only minor connection changes are required to adapt it to many services. These changes can be made in the field, in a minimum of time, without costly re-modeling.

This versatility permits *one basic unit* to be used as required for any of the pressure and volume control services described above. Absolute accuracy is provided in each application.

Complete information on the unit may be obtained from your GOT-OLSCO representative or through inquiry to Garrett Oil Tools, P. O. Box 6115, Houston 6, Texas.

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Water Disposal? - - - or CYCLING?

Now that the word "cycling" has been accepted widely, defined adequately, and distinguished carefully from "recycling" in gas field terminology,* it might become appropriate to use this word to describe more aptly oil field water disposal or injection systems that return oil field waters to the producing formations. Salt water disposal systems where water produced with the oil is returned to the water bearing portion of the oil producing reservoir might be called *salt water cycling systems.* Salt water disposal or injection systems that do not return the water to the oil producing reservoir would not be called water *cycling* systems.

The word *cycling* would thus denote systems where oil field water is put back into the producing formation usually at some point below the water-oil contact. Unlike gas cycling systems, however, any pressure maintenance or water flooding effects of water cycling systems should be considered as incidental benefits and not the primary purpose for installation. Water cycling systems in some types of reservoirs may not maintain the pressure or increase the recovery of crude oil appreciably.

The giant salt water "disposal" system in the East Texas field is an example of what might thus be called a *salt water cycling system,* for water produced from the Woodbine formation is returned to that formation below the water-oil interface. The water disposal systems in the Talco field of Titus and Franklin counties, Texas, that inject water produced from the Paluxy formation into the shallower Woodbine formation are not cycling systems by the above definition.

In Midway, Arkansas, where extraneous water is being injected in the downstructure portion of the oil producing reservoir for the purpose of maintaining the reservoir pressure, the whole project is aptly called a *primary water pressure maintenance system,* or a *primary water flooding system.* That portion of the facilities used to return produced water to the oil reservoir might, however, be called the *water cycling portion.* A similar distinction might be made between extraneous water injection facilities and produced water injection facilities in any water flooding or water pressure maintenance systems. Your reaction to the proposed use of the word cycling will be welcome in our "Letters to the Editor" column. Let us know if you have other suggestions for improving oil field terminology.

*See the editorial, "Cycling vs. Recycling," by K. C. Sclater in *The Petroleum Engineer,* February, 1941.

K Marshall Fagin

WITH BAKER *Triplex* EQUIPMENT

. . . You can secure a good, "first-time" cement job while protecting permeable, low-pressure zones below from cement contamination.

The difficult problem of cementing a string of casing at a predetermined point above the bottom of the hole, while protecting a permeable, low-pressure zone below from cement contamination is successfully being solved by using Baker Triplex Equipment.

The features of design and construction which insure its successful performance are "tried and true" Baker principles. Baker Metal Petal Baskets have been used universally for years in many types of cementing; and the Baker "Whirler" principle long has been proved superior to undirected jetting action, which may not only fail to eliminate channeling, but may wash out cavities, with resultant contamination of the cement slurry.

STRONG, SAFE CONSTRUCTION

The accompanying illustrations show how the full strength of the shoe has been retained. There are no thin walls or elongated slots to weaken the shoe.

Another safety feature is the use of a small diameter Tripping Ball which necessitates only a small hole through the Baffle Collar, often used as optional equipment. This design assures that the cementing plug will be stopped at the Baffle Collar, and eliminates the hazard of cement contamination.

The positive acting, back-pressure valve for the cementing ports in Triplex Equipment is another important safety feature. The instant pump pressure is stopped, this back-pressure valve closes, and thereafter, even though leaks may develop in the casing or in the surface equipment, the cement will *remain in place behind the casing until it sets.*

When it is desirable to wash and condition the hole preparatory to cementing, the Baker Triplex Cementing Shoe (Product No. 136) operates as a conventional float shoe. When cementing, all cement slurry is *retained above the "basket" surrounding the shoe,* and lower permeable formations are thus protected from contamination by the cement slurry.

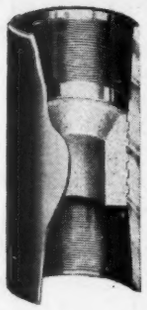
POSITIVE PERFORMANCE

All cement slurry is directed upward through side whirler ports of the shoe, and a back-pressure valve prevents any return flow of the slurry. The Baker Metal Petal Basket forms a bridge even in large diameter holes —readily conforms to hole irregularities over a wide range of diameters, and prevents the cement slurry from settling in permeable, low-pressure zones below.

ACCESSORY EQUIPMENT OPTIONAL

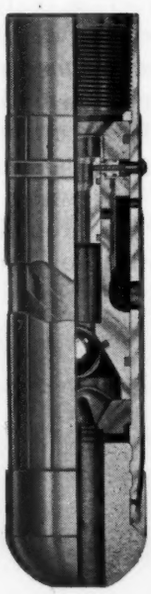
When it is desired to retain cement tailings inside the casing (thus preventing dilution of the cement slurry around and above the Triplex Shoe or Collar) either of two collars may be used:

(a) Baker Triplex Cement Baffle



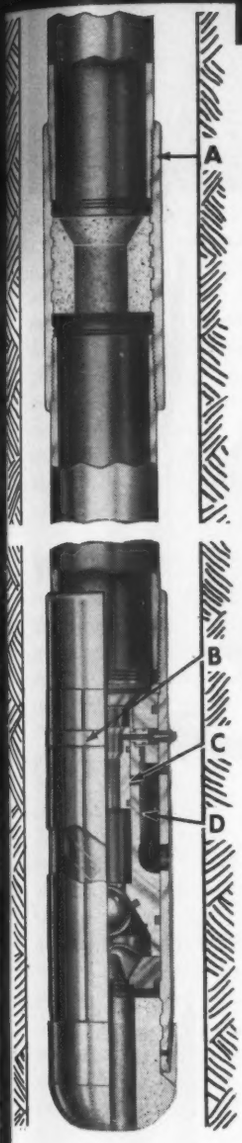
Baker Triplex Cement Baffle Collar (Product No. 137) is used when a stop for the cementing plug is desired, to retain cement tailings inside the casing.

Baker Triplex Flapper Valve Float Collar (Product No. 134 M&F) provides the safety of an additional float valve, as well as a stop for the cementing plug.

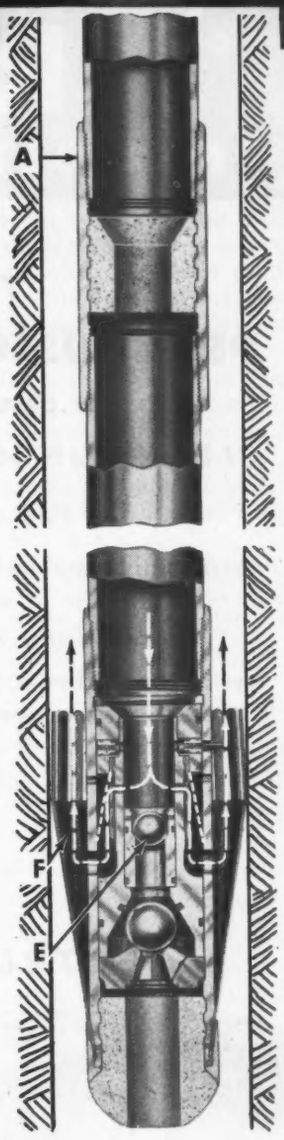


Baker Triplex Cementing Shoe, Product No. 136. Named "Triplex" because it performs a "triple" service: (1) is an efficient float shoe for running-in the casing; (2) whirls the cement slurry upward to minimize danger of channeling; (3) Metal Petal Basket expands to form a bridge which prevents cement contamination of low-pressure zones below.

HERE'S HOW THE *Triplex* CEMENTING SHOE BRINGS YOU "BAKERESULTS"



Ⓐ Baker Triplex Cement Baffle Collar, installed a joint or two above the shoe, serves as a stop for the cementing plug. Ⓑ A hold-down strap (secured by shear screws) retains the Baker Metal Petal Basket close against the shoe or collar while running-in the casing and conditioning the hole. Ⓒ Cementing ports are covered by the Tripping Valve until cementing is commenced. Ⓓ A fabric-reinforced, resilient rubber, sleeve-type, back-pressure valve opens readily (see dotted white line) to permit passage of the cement slurry into the annulus above, but closes instantly to prevent any return flow of the slurry. Ⓔ After reaching the desired point in the hole, circulation is established through the ample central passageway. A Tripping Ball now is pumped (or allowed to gravitate) down the hole to seat upon the Tripping Valve. Pressure of 400 to 500 psi is applied to the casing, which shears the Tripping Valve shear screws and forces the Tripping Valve downward to expose the cementing ports. Ⓕ Shearing the screws also releases the Basket hold-down strap and allows the Metal Petal Basket to expand outwardly against the wall of the hole. The Basket with which each Triplex Shoe is equipped has a wide range of expansion and forms a bridge in large-diameter, or irregular-shaped holes far beyond the range of a rubber packing element. The cementing operation now is carried out in the conventional manner with the cement slurry directed upward with the exclusive Baker "Whirler" action. This "Whirler" principle has proved to be far superior to an undirected jetting action which does not minimize the hazard of channeling, and may wash out cavities and cause cement contamination. Only readily drillable materials are used for all internal parts; and two one-half inch set screws hold the inner assembly stationary to facilitate drilling out.



BAKER OIL TOOLS, INC.

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Collar (Product No. 137) which is *not* equipped with a float valve, but acts as an effective stop for the cementing plug;

(b) Baker Triplex Flapper Valve Float Collar (Product No. 134 M&F) which not only serves as an effective stop for the cementing plug, but provides the added safety of an additional float valve. See illustration for details of the bevelled-top, hollow magnesium casting with a hole of sufficient inside diameter to pass the 1¾-inch O.D. Tripping Ball used with all sizes of Triplex Equipment; see also illustration on opposite page.

POPULAR SIZES AVAILABLE

All types of Baker Triplex Cementing Equipment can be secured promptly in API sizes from 4½" to 8⅝". Any Baker serviceman or Baker office will gladly provide additional information and see that your needs receive immediate attention.

For complete details look in your Baker (or Composite) Catalog.

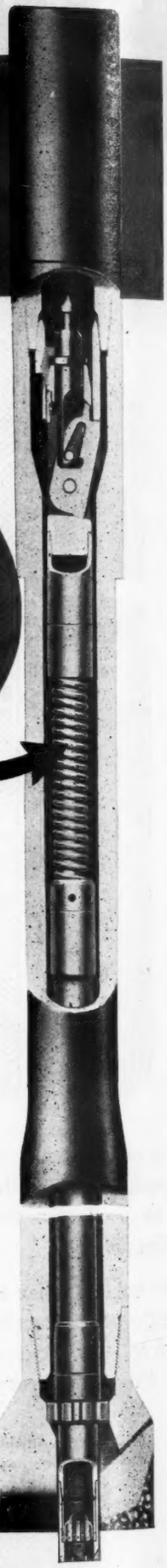
BAKER *Triplex*

CEMENTING EQUIPMENT

Specify the

REED "BR"

FOR BETTER *Wire Line* CORING

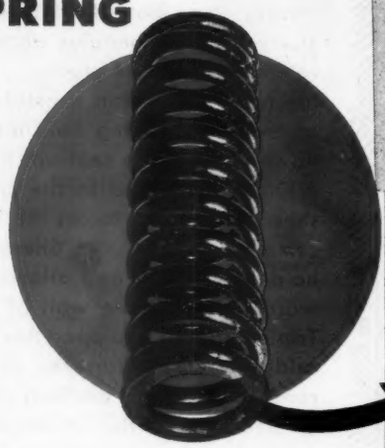


This Simple

PROTRUSION REGULATOR SPRING

assures recovery of

CLEAN, UNCONTAMINATED CORES



This retractable feature:

★ Permits the cutter head to protrude ahead of drilling bit in soft formations.
Assures clean, uncontaminated cores.

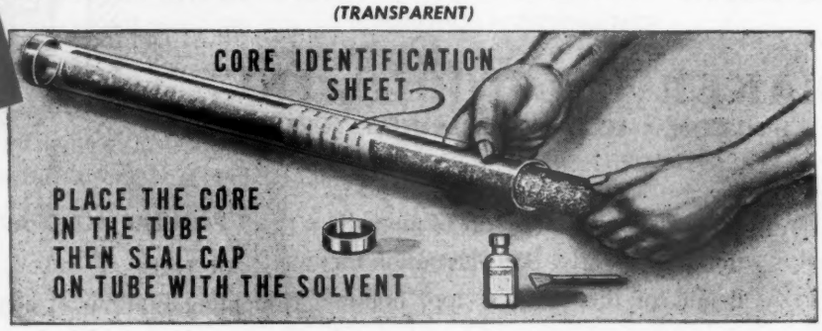
★ Permits the cutter head to retract within the drilling bit when hard streaks are encountered, or when using hard formation drilling bits.
Protects core cutter head from too much weight.

PROTECT YOUR CORES WITH

EXTRULITE PLASTIC CORE TUBES

(TRANSPARENT)

NEW!



- Cores can be tagged and sealed at the rig
- Protects the core from air, gas, oil and water
- Cores can be stored for permanent protection
- Core identification sheet can be sealed in tube for easy reading from the outside
- Core tubes are durable enough for shipping without further wrapping

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HOUSTON 1, TEXAS

Treating East Texas Oil Field Water

ROY H. ZUFELDT*

Water flooding of sub-surface oil reservoirs is becoming a more common operation. With certain waters, it is necessary to chemically treat the water before injecting it so that the water will not plug up the injection strata. This paper discusses several methods of water treatment used in the East Texas field. Special emphasis is placed on the use of potassium permanganate, the various unit operations and processes involved with the use of potassium permanganate, and the economic aspects of this method of treatment.

WATER flooding of sub-surface oil reservoirs to effect more complete ultimate recovery of the oil is becoming a widespread operation throughout the industry. Aside from increasing the recovery of oil and helping maintain or raise the bottom hole pressure, injection of the water produced with the oil is often the most satisfactory method of disposing of a fluid that may pollute streams and kill vegetable life. Whether or not the water produced with the oil will contaminate land and streams, the kind of chemical treatment to be given the water depends on the kind and amount of dissolved solids it contains.

In the East Texas oil field, half a million barrels of salt water are produced every day or about two bbl of salt water to one bbl of oil. This water contains an average of 35,000 ppm chlorides making it too salty to drink, or to use for irrigation. The injection of this salt water into the Woodbine Sand from whence it came, below the level of the oil-water contact has brought the decline in bottom hole pressure almost to a standstill, has solved a very acute pollution problem, and has increased the estimated ultimate recovery of the Woodbine reservoir by some 600,000,000 bbl.[1]

The type of conditioning method to use, the kind and amount of chemicals to employ, and the points of application are determined by many factors such as:

1. The chemical analysis of the water.
2. The pH of the water.
3. The type of underground formation which is to receive the water.
4. The kind of bacteria or algae in the water.
5. Whether the water is taken directly from the heater-treater or from open collection pits.
6. The amount of oil in the water, and
7. Various economic factors.

If conditioning is desired any one of several systems may be used. The most common methods are the closed system, the open-closed system, and the open system.

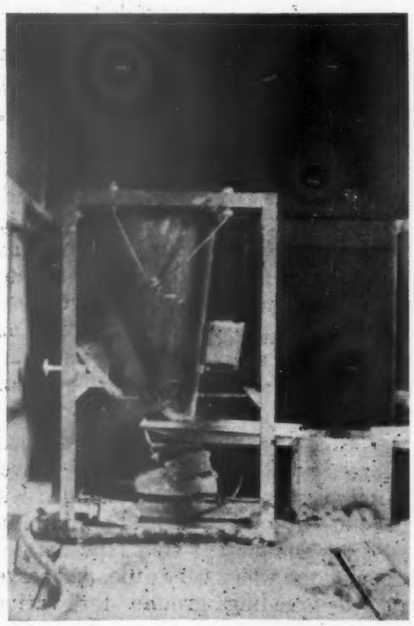
Closed System

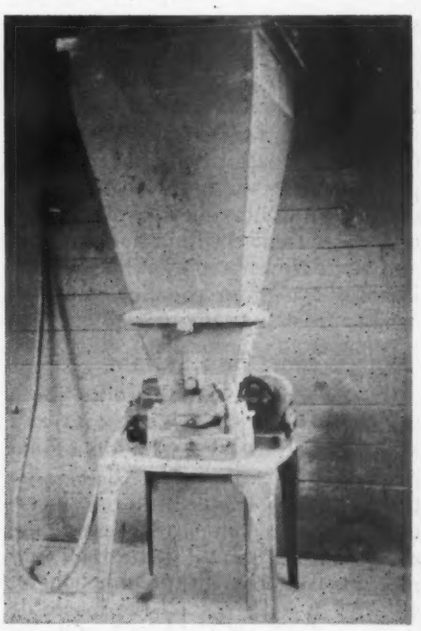
The closed system is based on the principle that the various chemicals in the water are in equilibrium as they leave the reservoir. If no substance, such as oxygen, pollutes the water to cause some reaction and throw this equilibrium out of balance, the chemicals in the water will remain in equilibrium or in solution, and no precipitates will form to plug the injection sand. A closed system is most applicable for small projects (up to 5000 bbl per day) where the water can be kept under constant control and where treating systems, other than skimming and filtering, would be too expensive. Due to the difficulty of eliminating all air from the water and maintaining the same temperature and pressure as that of the reservoir, it is often impractical to attempt to keep the chemicals in the water in equilibrium. For this reason the East Texas Salt Water Disposal Company converted the only closed system it had in operation to an open system several years ago.

The "Open-Closed" System

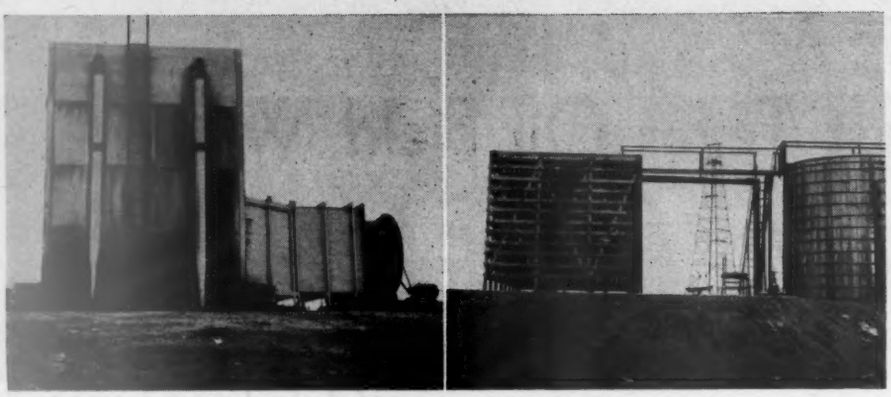
The open-closed system is so called, because although the water is exposed to the atmosphere, closed system

Two types of chemical feeders used to feed lime and alum into the salt water. The one on the left is a vibratory type feeder, and the rate of feed is adjusted by varying the intensity and period of vibration. The feeder on the right is a sliding tray type of feeder. The chemical falls upon a tray that moves in a reciprocating motion. The rate of feed is regulated by varying the length of the stroke of the tray and the clearance above the tray.





*Formerly with East Texas Salt Water Disposal Company and now with The Texas Company.



Two types of aerators used to treat the salt water. The one on the left is a forced convection type aerator, the air blows countercurrent to the flow of the water. The illustration on the right illustrates a natural convection type aerator, without louvers and a tank where any oil in the water is skimmed off prior to aeration.

principles are used. Sulphuric acid is added to reduce the pH of the water from 7.0 to about 5.6 to keep iron and calcium compounds in solution and to eliminate bacteria. Chlorine is added to combine with any hydrogen sulphide that forms in the water before it enters the treating pit. H_2S plus Cl_2 yields 2HCl plus S.

With this treatment, the injection wells in the East Texas field will usually take from 8000 to 10,000 bbl per day or more on gravity, and much expensive equipment is eliminated. However, chemical costs are high and the use of sulphuric acid is preferable where high injection pressures can be anticipated, but not where the sand is permeable enough to use another method of treatment. The cost of the sulphuric acid alone to reduce the pH of the water to 5.6 would range from $20 to $25 per 10,000 bbl of salt water treated.

Water treated with sulphuric acid cannot be mixed with water treated with lime, alum, and chlorine, or potassium permanganate, without retreating, because of the difference in pH. It is interesting to note that water treated with potassium permanganate and water treated with chlorine, lime, and alum are very compatible. In fact, if desired, all four chemicals may be used to treat the same water.

The Open System

The open system includes both treatment with chlorine, lime, and alum, and treatment with potassium permanganate. It is based on the theory that since the water will certainly come in contact with some oxygen, the water should be brought into intimate contact with the atmosphere, allowed to settle out all the insoluble compounds that form, and be filtered to obtain a clear stabilized water for injection.

In this method of treatment, the water is first skimmed in a pit or tank to remove any oil that may be mixed with it as it leaves the gun barrel. A tank with one or more baffles is generally preferable. Typical baffling ararangements are shown in Fig. 1. The amount of baffling required depends on the oil-water emulsion. If too much oil is allowed to remain in the water, it may agglomerate with the chemicals added and necessitate the recharging of the filters. In some cases, electrical or chemical treatment is required.

Aeration

The water passes from the skimmer to the aerator. The amount of aeration depends on economic considerations; however, from the standpoint of water treatment, it is impossible to aerate the water too much. Aeration tends to kill or render inactive much of the bacteria, convert some of the calcium bicarbonates to carbonates ($Ca(HCO_3)_2$ yields $CaCO_3$ plus H_2O plus CO_2), oxidize the ferrous bicarbonates to ferric hydroxide, ($2Fe(HCO_3)_2$ plus $\frac{1}{2}O_2$ plus H_2O yields $2Fe(OH)_3$ plus 4 CO_2), and lower the temperature of the water. The lowering of the temperature also retards the growth of the bacteria and causes the calcium bicarbonates that do not precipitate to become more stabilized.

After some experimentation with forced-draft aerators, natural convection aerators were recommended with the use of louvers kept to a minimum. It was found that slab type aerators cooled the water very little, and served as a breeding ground for various bacteria.

Additions of Chemicals

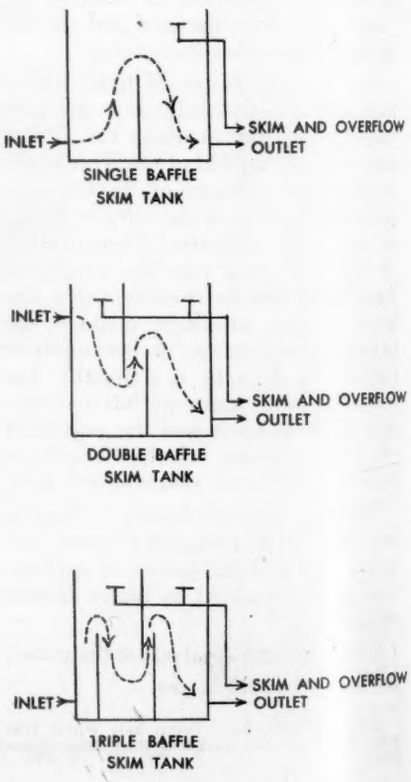
The various chemicals that are to be mixed with the water are usually added after aeration as the water enters a flocculation pit, the purpose of which is to expedite the formation of floc. The pit is usually about 10 ft square and about 6 ft deep for a plant handling 10,000 to 20,000 bbl per day.

The water goes into the settling pit from the flocculation pit by way of a distribution trough. This pit is of sufficient size to provide a retention time of 12 to 24 hr and is usually divided into several sections by over and under baffles. To move from one section of the pit to the next, the water must go over a baffle, down between the two baffles, and out under a baffle. The space between the baffles is usually 6 to 8 in.; therefore, the velocity of the water as it flows between the baffles is accelerated. After the water passes out under the second baffle, the velocity decreases. Thus the baffling arrangement tends to throw the floc out of the water down on the bottom of the pit. The layer of floc and sludge on the bottom of the pit aids in separating out the floc.

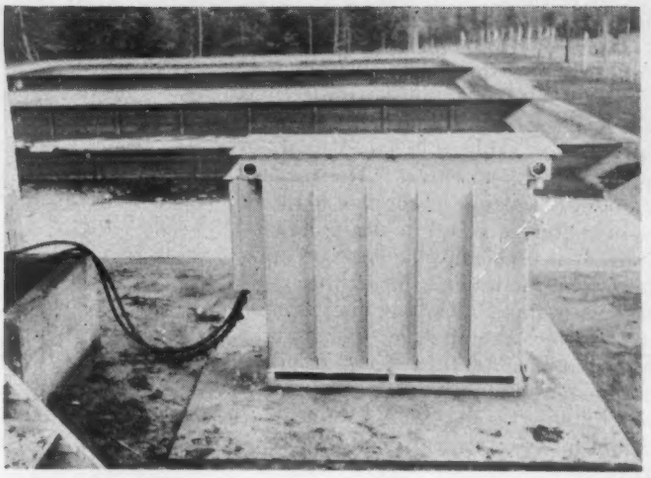
Filters

The water leaves the settling pit through a uniform takeoff header pipe and is filtered. Filters are usually

FIG. 1



A gunite settling pit in process of construction. The men in the background are applying gunite to the wire mesh. The men in the foreground are fine grading the sides of the pit. The concrete foundations that traverse the bottom of the pit will support wooden baffles.



Oil-cooled rectifier used to convert 440 volts ac-current (3 phase) to 500 amps dc-current at 5 v. Current is fed to carbon electrodes by cables on the left. These electrodes are immersed in salt water and generate nascent chlorine and oxygen by a partial electrolysis of the salt water.

made of light steel, 96 in. in diam, 54 in. high, plastic lined, equipped with asbestos-cement underdrains, and charged with either sand and gravel or graded anthracite coal. Generally the higher cost of the coal is justified, because it does not cement and channel as badly or as quickly as sand and gravel. Also, anthracite coal removes some silica from the water. It may be observed from Table "B" that silica is the major component obtained in well clean out jobs. Therefore this advantage of anthracite coal is important.

The filtered water is metered as it passes to the surge tank. The meter may either be a conventional turbine type meter or a weir box with a flow meter and recorder attached. The surge tank serves as a safety measure to keep the injection pumps from air locking. Also, the appearance of the water in the surge tank serves to indicate roughly the efficiency of the treatment given the water.

Injection Pumps

Reciprocating pumps are used to inject the water into the ground when pressure is necessary. Some wells take only 2000 bbl per day under 200-300 psig, while others take up to 20,000 bbl per day under vacuum. The amount of water a well will take is roughly proportional to the thickness of the sand section receiving the water.

Chemical Treatment

If the water is treated with chlorine, lime, and alum, the chlorine acts to retard or prevent the growth of algae and bacteria and help complete the oxidation of the iron from the bivalent to the trivalent state. An attempt is made to maintain the residual chlorine in the water in the surge tank at from 0.1 to 0.25 ppm. The water is chlorinated either by electrolysis with about 500 amp at 5 v direct current or by adding chlorine from a cylinder.

Lime is added solely to help settle the water and not to "soften" it or to try to remove the bicarbonates. When the water contains, on an average, more than 450 ppm bicarbonates, the cost would be prohibitive to try to soften this water, and the treating pit would soon be full of calcium carbonate.

At one plant that may be taken as a typical example (Suman) the bicarbonate hardness, as $CaCO_3$, before treatment was 477 ppm. After treatment, the water had a bicarbonate hardness of 450 ppm. About 8 lb of lime and 8 lb of alum are added per 1000 bbl of water treated.

Alum, in the form of aluminum sulphate, $Al_2(SO_4)_3$, is added as a flocculating agent to help settle out the ferric hydroxide and any calcium carbonate that may have formed.

$Al_2(SO_4)_3$ plus $6H_2O$ yields $2Al(OH)_3$ plus $3H_2SO_4$.

Cost of Treatment

This method of chemical treatment costs about $2.60 per 10,000 bbl of water treated for chemicals and maintenance costs. Considering depreciation of the chemical feeders and rectifiers, and electric power costs, the over-all cost of treating water in 1947 by the East Texas Salt Water Disposal Company was $4.00 per 10,000 bbl or 0.4 mills per bbl.

This system when operating properly causes the iron to drop out and clarifies the water so that the water in the surge tank after filtration is crystal clear. The treating costs are only a fraction of the chemical costs involved with sulphuric acid treatment. It is not, however, without some drawbacks.

The average plant treats 10,000 bbl per day. The addition of an average of 8 lb of lime and 8 lb of alum per 1000 bbl will amount to 58,400 lb, or more than 29 tons of chemicals per year. The 29 tons plus whatever iron, calcium, and other salts that precipitate, settle out and fill the treating pit or the filter media. A treating plant where this method of treatment is employed is down about two days each year while the settling pit is cleaned. If the water is injected for a fee, as in the case of the East Texas Salt Water Disposal Company (1.8 cents per barrel), this would mean that about $360 was lost in addition to the labor and equipment costs involved in cleaning the pit.

A second difficulty in this method of treatment is the addition of lime to help settle the water. As brought out before, the addition of lime to the water converts only a small proportion of the bicarbonates to carbonates. However, since the molecular weight of lime, $Ca(OH)_2$, is 74 and the molecular weight of calcium carbonate is 100, 8 lb of lime per 1000 bbl of water will form not just 29,200 lb of calcium carbonate but 39,500 lb per year in a 10,000 bbl per day plant. $Ca(OH)_2$ plus $Ca(HCO_3)$ yields $2CaCO_3$ plus $2H_2O$. This would make the pit cleaning problem even worse, if it all settled out, but all of it does

not precipitate in the settling pit.

Calcium carbonate, though only souble to the extent of about 12 ppm at 77 deg F has the troublesome property of forming supersaturated solutions in which considerably more than 12 ppm may be dissolved. This excess amount of calcium carbonate is likely to come out of solution at almost any time. It is especially likely to precipitate when the water is brought in contact with small particles that offer a nucleus for precipitation, such as fine filter media. As the excess calcium carbonate gradually and continually precipitates in the filter media, the media tends to cement itself together. This is particularly true if sand is used. As a consequence of the cementing action, the sand and gravel in filters handling this type of salt water must be replaced about once a year. The cost is about $150 per filter and a plant handling 10,000 bbl per day usually has about three filters.

Potassium Permanganate

When potassium permanganate is used to treat salt water, chlorine, lime, and alum are not necessary. However, any or all of these chemicals may be used with it. Sodium hexametaphosphate may also be used with potassium permanganate to stabilize the bicarbonate ions. Potassium permanganate is used as an oxidizing agent to retard the growth of bacteria and complete the oxidation of ferrous salts to the more insoluable ferric compounds. The concentration of reducing compounds in the water and the pH of the water influence the oxidizing power of the potassium permanganate. A high hydrogen ion concentration increases the oxidizing power of potassium permanganate.

Whether the solution as a whole tends to be reduced or oxidized, however, depends upon the ratio of oxidizing substances to reducing substances. Generally, nothing is done to adjust the pH of the water or regulate the amount of reducing substances in the water. However, enough potassium permanganate is added to make sure the various ferrous compounds are oxidized after the addition of the chemical.

Table A. Usual chemical composition of East Texas oil-field salt water.

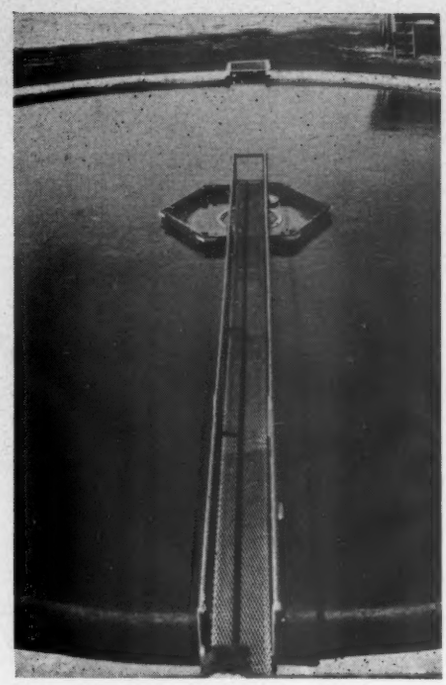
Component	Concentration in parts per million		
	minimum	average	maximum
Sodium	19,000	22,500	24,000
Calcium	1,300	1,500	1,750
Magnesium	35	450	540
Sulfates	175	220	260
Chlorides	29,000	35,000	39,000
Carbonates	0	0	0
Bicarbonates	3	7	16
Iron	0	3	15

Table B. A partial analysis of insoluble residues in East Texas salt water.

	1	2	3	4
$CaCO_3$	16.10%	8.10%	7.00%	1.13%
$CaSO_4$	3.30%	11.30%	.....	.....
FeS	24.30%	25.10%	10.70%	4.40%
$MgCO_3$	0.26%	0.21%	2.80%	3.26%
Al_2O_3	15.30%	10.60%	5.80%	0.30%
SiO_2	13.30%	22.60%	69.20%	83.30%

1. Floc from the intake pit at Starnes system.
2. Floc from the bottom of settling pit No. 3 at discharge pipe, Starnes system.
3. Residue from clean-out job on the Shaw injection well.
4. Scrapings from tubing job, an East Texas injection well.

The above data are taken from a tabulation on p. 14, of "Investigations Dealing with the Disposal of East Texas Oil-Field Water," by F. B. Plummer, Bureau of Engineering Research, The University of Texas, Austin, Texas, 1945.



A circular settling pit. The water enters the pit at the center and passes under and over a series of baffles before flowing over the sides of the pit into the surrounding trough. The water flows in this trough to a take-off pipe, which carries it to the filters. This is the only large pit in service at the present time by the East Texas Salt Water Disposal Company that utilizes radial flow to help settle the water.

Bacteria

East Texas oil field salt water contains anaerobic bacteria and probably the faculative and aerobic types. During the summer, difficulties experienced with bacteria are accentuated. One type of bacteria that is known to be in the salt water and is thought to be resistant to chlorine is vibrio thermodesulfuricans,[2] an anaerobic sulphate reducing bacteria. This bacteria acts to reduce the sulphates in the water to sulphides and eventually causes the iron, in solution as ferrous bicarbonate, to come out of solution as black specks of ferrous sulphide by the following reaction:

Na_2SO_4 plus bacteria yields Na_2S plus O_2 (bacteria uses up O_2).

Na_2S plus $2H_2O$ yields H_2S plus 2NaOH.

H_2S plus $Fe(HCO_3)_2$ yields FeS plus 2 H_2O plus CO_2.

This black, fine ferrous sulphide will readily plug up injection sands.

F. B. Plummer of the University of Texas found that one part of formaldehyde would sterilize 25,000 parts of water containing this bacteria.[3] The cost of such treatment would be prohibitive, but investigations as to whether smaller dosages of formaldehyde would accomplish the same result might be worth while. Concerning the ability of potassium permanganate to kill the bacteria, Plummer made no comment, but found that in East Texas salt water, potassium permanganate was a more powerful oxidizing agent than either chlorine or potassium chlorate. Starkey and Wight[4] found that the anaerobic bacteria that attack pipe lines are passivated by oxidation-reduction potentials and cannot live in an atmosphere where this potential is 0.4 v or higher.

Potassium permanganate is an effective bactericide. It is used medicinally as a disinfectant. In an alkaline solution, potassium permanganate has an oxidation potential of 0.54 v as it undergoes the following reaction[5]:

$$e \text{ plus } MnO_4^- \rightarrow MnO_4^=$$

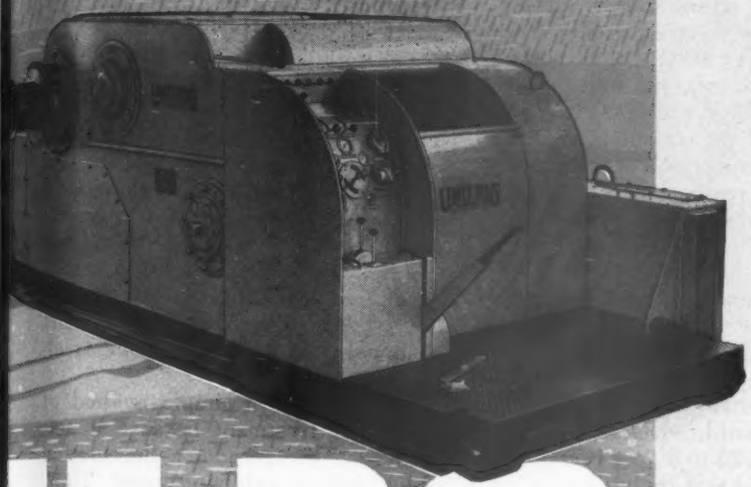
In an acidic solution, potassium permanganate has an oxidation potential of 1.52 v as it undergoes the following reaction[6]:

$$MnO_4^- \text{ plus } 8H^+ \text{ plus } 5e \rightarrow Mn^{++} \text{ plus } 4H_2O$$

Field experience shows that potassium permanganate when used at the rate of 1.1 lb per 1000 bbl will inhibit the growth of bacteria, but will not eliminate it. At one plant, water treated with 1.1 lb of potassium permanganate per 1000 bbl had a redox potential of 340 mv while the water after aeration but before treatment, had a redox potential of 40 mv.

Potassium permanganate will also act to oxidize the reactive ferrous salts in the water to ferric salts and thereby make them less susceptible of forming ferrous sulphide with any hydrogen sulphide that is produced. Plummer gives the following reaction as the one that takes place when ferrous bicarbonate is mixed with potassium permanganate:

When you've got to go DEEP....



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$6Fe(HCO_3)_2$ plus $2KMnO_4$ plus $3H_2O$ yields $6Fe(OH)_3$ plus $2MnO_2$ plus $11CO_2$ plus K_2CO_3

One molecule of potassium permanganate will thus precipitate three molecules of ferrous bicarbonate, and the manganese ion goes from a valence of plus seven to plus four which should result in a high redox potential, theoretically 1.63 v.[7] Also, the reaction should go to completion since all reagents entering into it are soluble and both the ferric hydroxide and the manganese tend to act as flocculating agents as they settle out and help bring down suspended solids in the water. This floc does not settle out as fast, however, as the floc produced by aluminum sulphate. The carbon dioxide that is produced tends to stabilize the calcium bicarbonates in the water and keep the filter media from cementing.

In the treatment of water with potassium permanganate, two of the properties of the chemical must be considered or difficulties will be met in feeding it into the water. First, it is hygroscopic and will stop up a dry chemical feeder such as is commonly used to feed lime or alum into water. Second, in solution it is a very corrosive chemical and will oxidize materials just as it oxidizes chemicals in the water. After some experimentation with various methods of feeding the chemical into the water, a diaphram pump was found to perform satisfactorily in pumping a measured volume of a concentrated solution of potassium permanganate into the water. These feeders will operate three months or more without maintenance.

Also, as mentioned above, the floc formed by potassium permanganate does not settle out as easily as floc formed by aluminum sulphate. In a new or clean settling pit, this can place an excessively heavy load on the filters. The trouble can be remedied by adding lime and alum with the potassium permanganate until a sludge blanket has had time to build up in the pit so that the water is slightly filtered as it passes from section to section.

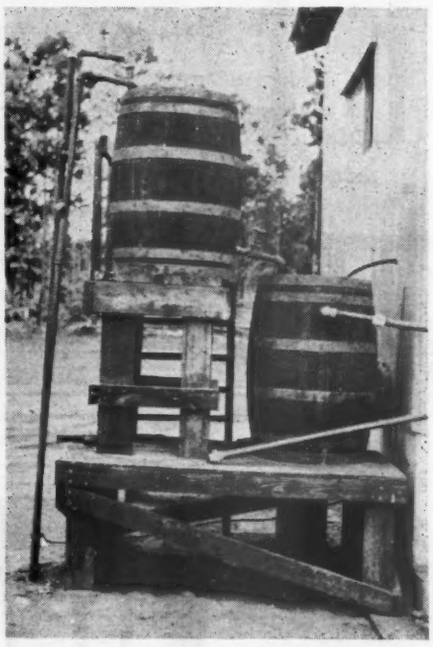
From the standpoint of safety, potassium permanganate is far less dangerous than either chlorine or sulphuric acid. It presents an explosive hazard if stored with sulphuric acid, and when in solution, it will stain the skin. The worst danger is to get some of the dry chemical or concentrated solution in the eyes. Fortunately, no one has been hurt handling potassium permanganate in the year and a half it has been used by the East Texas Salt Water Disposal Company.

From the standpoint of performance, when treatment was changed from lime, alum, and chlorine to potassium permanganate, wells in the East Texas Field took water with improved or equal facility.

Economics

From the standpoint of economics, treatment of salt water with potassium permanganate offers substantial savings. With the dosage varying from 1.1 to 1.25 lb per 1000 bbl, the cost of the chemical to treat the water varies from 24 to 27½¢ per 1000 bbl. Depreciation of the chemical feeding equipment over a period of three years at the average treating plant will raise the total cost of water treatment to 27¢ to 30¢ per 1000 bbl. The difference in this cost and the cost of treating the water with chlorine, lime, and alum for the amount of water injected annually by the East Texas Salt Water Disposal Company is about $15,000 per year. The change to potassium permanganate should reduce water treating costs from 25 to 30 per cent.

It is believed that the utilization of potassium permanganate to treat salt water before injecting it is a step forward in the economical operation of salt water injection systems. At the present time, the use of some of the polyphosphate compounds to maintain the iron and calcium bicarbonates in solution appears to be promising. Experimental work is being carried on with sodium hexametaphosphate in an effort to accomplish the benefits obtained with the sulphuric acid treatment, but with less expense.



These barrels are used to dissolve the potassium permanganate and store the solution until it is fed into the water. The solution is made up by dissolving a known weight of chemical in a barrel of water so that the concentration is known. This solution is drained into the lower barrel from which the diaphragm pump (located in adjoining house) takes suction.

Conclusions

First, potassium permanganate is applicable to the open system treatment only.

Second, while it is hoped that an even better and more economical method of treatment can be developed, at the present time, potassium permanganate seems to have several advantages over other chemicals in use as water treating agents, as follows:

First, is is safer to handle than many chemicals used in salt water treatment.

Second, it is a simple method of salt water treatment because it acts both as a bactericide, a flocculating agent, and an oxidizing agent. Thus, this one chemical can obtain the results normally obtained with two or three chemicals.

Third, it is a more economical method of treatment than either sulphuric acid or lime, alum, and chlorine.

Fourth, judging by the well histories where treatment with potassium permanganate has supplanted treatment with lime, alum, and chlorine, potassium permanganate does as good a job of stabilizing the salt water before injection as lime, alum, and chlorine.

Acknowledgement

The author wishes to express his thanks to L. H. Dial, chief engineer, and W. S. Morris, vice president and general manager, both with the East Texas Salt Water Disposal Company, for their assistance and suggestions in the preparation of this paper, and to acknowledge the pioneer research work done in this field by the late F. B. Plummer of the University of Texas.

References

1. W. S. Morris, Vice President and General Manager of the East Texas Salt Water Disposal Company, in a talk to Petroleum Engineering students of Texas A. & M., April, 1948.
2. F. B. Plummer and I. W. Walling, AIME Tech. Publication No. 2019 *Petroleum Technology March*, 1946.
3. Ibid.
4. R. L. Starkey and K. M. Wight, "Anaerobic Corrosion of Iron in Soil," *Corrosion*, May, 1947.
5. I. M. Kolthoff and H. A. Laitiner, *pH and Electro Filtrations* 2nd Ed., page 67-68, John Wiley and Sons, Inc., 1941.
6. Ibid.
7. F. B. Plummer, *Investigation Dealing with the Disposal of East Texas Oil Field Water*, pages 37 and 39. The University of Texas, Bureau of Engineering Research, Austin 12, Texas, 1945.

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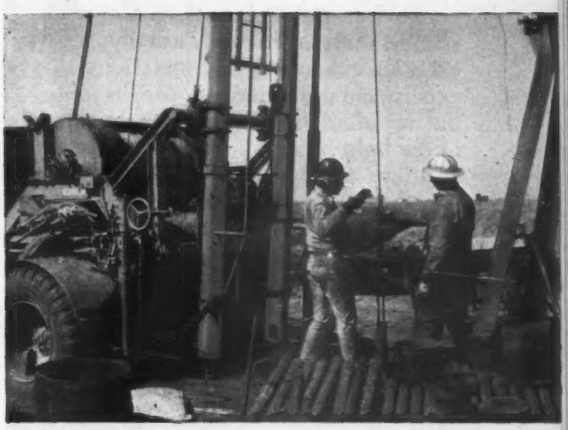

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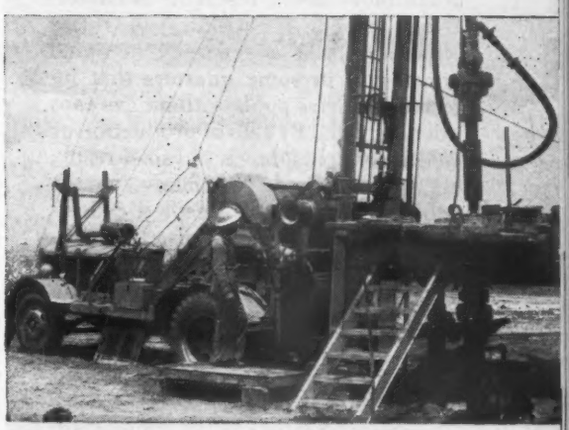

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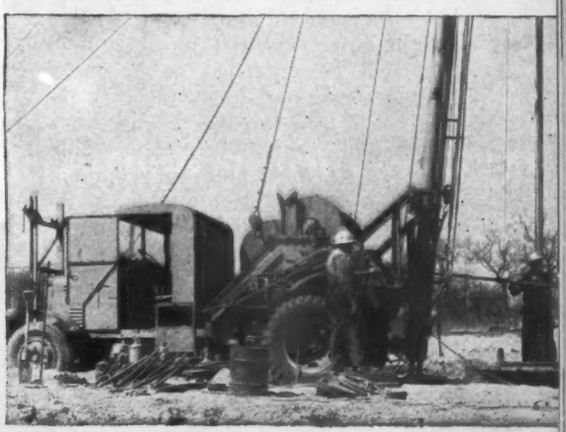

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Oil Production Research

T. A. POLLARD*

RESEARCH has sometimes been defined as work on a problem that has no solution. A somewhat more lenient definition states that 90 per cent of all research efforts turn out to be failures. These startling statements constitute one way of defining research, since, if the answers to research problems were evident and easy of solution, the work would not be research.

There are other ways of defining research. Gaylord[1] has said that research is any effort by which we acquire new knowledge. Webster's definition is somewhat more lengthy: Careful search, studious inquiry, usually critical and exhaustive investigations or experimentation, having for its aim the revision of accepted conclusions in the light of newly discovered facts. I believe it important to emphasize the phrase, "revision of accepted conclusions." What does this mean? Some examples are as follows:

The revision of accepted conclusions might mean that a "5 cc" mud is not actually a good mud after all, even though one of the criteria used in the tests for describing good muds has been that of low water loss. As we learn more about reservoir behavior, it may become necessary to revise what has been a generally accepted conclusion in some quarters that internal gas drive pools without gas caps are unaffected by rate of production or well spacing insofar as physical recovery is concerned. Not many months ago, the revision of accepted conclusions might have meant also the realization that there could be better ways of getting holes in casing than by using bullets.

Definition

Oil production is sometimes defined to include problems of exploration for oil and some phases of oil processing. For the general purposes of this article, however, the term oil production will be regarded in its more limited sense, and oil production research will be defined as the discovery and development by any conceivable means of all practicable and economic techniques for increasing the ultimate recovery of hydrocarbons from buried earth strata. This definition is intended to cover problems of drilling as well as other phases of oil producing activity, for drilling operations have a decided effect on the economy of oil recovery.

Need for Research

There are a number of reasons for engaging in research on oil production methods that are obvious to most people closely identified with the oil industry. One of these is the unprecedented demand for petroleum and its products that developed during and after Word War II. The necessity for insuring supplies to meet this demand has obviously stimulated production research activity, which has gained momentum during recent years.

Another need for oil production research is defined by the relatively low recovery efficiencies presently existent in many oil reservoirs. Oil recoveries usually vary between 10 and 80 per cent of the oil in place, according to the particular characteristics of the oil reservoirs considered. Gaylord[1] has voiced the opinion that on the whole, at least half of the presently known oil in place will be left in the ground by present recovery methods. This obviously leaves room for tremendous improvement in the efficiency of exploitation of petroleum reservoirs.

Considerable difference of opinion has been evident in recent years regarding the probable extent of petroleum deposits within the United States. Regardless of what the actual magnitudes turn out to be, it can hardly be disputed that the number of petroleum deposits is limited, and that ultimately a situation will be approached in which availability of crude cannot keep up with domestic demand. For this reason, oil production research is needed in order to make the most of petroleum deposits that are discovered and exploited within this country.

Another incentive for extended oil production research at this time is the necessity for developing a domestic backlog of available petroleum in case of national emergency. There may be various ways of achieving this; properly directed production research can assist.

A further incentive for production research is the need for integrated companies to approach a better balance between crude oil reserves, availability, refinery capacity, and marketing outlets. Each company doubtless has its own conceptions of the best balance to be obtained in these matters, and those who have not been large producers in the past are now paying more and more attention to oil production research in order to improve their reserves and availability positions.

Agencies in Research

The general upsurge of interest in petroleum and petroleum supplies has brought into the field of production research almost every organization or agency that has a direct or indirect interest in petroleum production.

First among those interested in oil production research, of course, are the oil producing companies. Those active in this field include most of the larger operators; these number ten in the Southwest alone. Gaylord[1] has estimated that about 2000 people will be engaged by oil-producing companies on programs costing 15 to 20 million dollars in the year 1949. Present indications are that the number of people engaged and the amount of money expended on production research will increase slowly for the next several years.

Government agencies and institutions are also engaged in oil production research. One of the foremost of these is the United States Bureau of Mines, which has experimental stations in eight states engaged in all phases of production research from thermodynamics to water flooding. As is well known, this agency is also expending considerable effort on the problem of oil shale research. Several of the states are also engaged in production research, one example being the state of Texas through its Texas Petroleum Research Committee sponsored by the Railroad Commission of Texas and organized for work to be done jointly by The University of Texas and the Agricultural and Me-

*Magnolia Petroleum Company, Field Research Laboratories, Dallas, Texas.

[1]Gaylord, E. G., "The Role of Research in the Production of Oil", presented at the annual meeting of the American Petroleum Institute, Chicago, Illinois, November, 1948.

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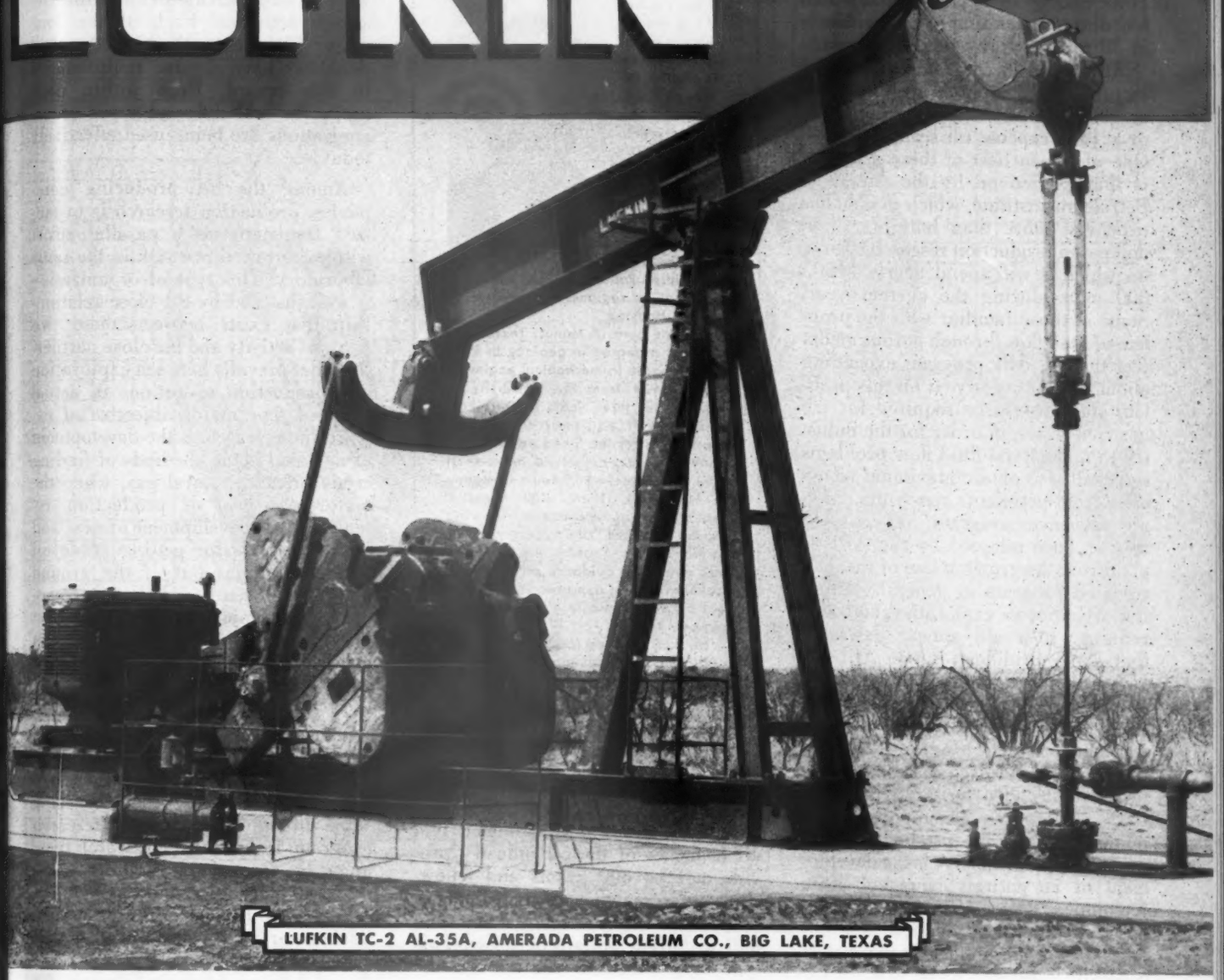

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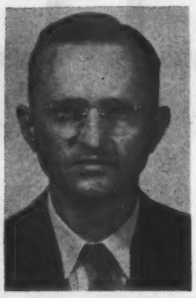
chanical College of Texas. Another active program is under way at Penn State College in Pennsylvania, which has devoted attention to the problems of oil recovery for a number of years.

Additional organizations engaged in production research are those that conduct such activities by joint effort or at joint expense for several parties. One of the earliest of these activities is that carried on by the American Petroleum Institute, which to date has expended more than half a million dollars on production research efforts, on which it will spend nearly $150,000 more during the current year. Some of those familiar with the problem of fluid flow through porous media feel that an API program expending about $500,000 per year on this problem alone would be required for the next few years, in order for the industry to understand fluid flow problems sufficiently to obtain maximum recoveries from petroleum reservoirs. Such an extensive program has not, of course, been adopted by the API as yet. From the growing size of the API research program in general, including activities in exploration and also refining, it would appear desirable that some modifications of API organization to handle research be instituted. This matter is now under study by various Institute committees. Another research program that has recently been instituted as a joint effort is that called Drilling Research, Inc. This program is supported by a number of the oil producing companies, and its objective is the development of an entirely new and more economical means of making holes in the earth for oil production. The undertaking is an ambitious one and is generally conceded to be a more expensive program than any one oil company would care to undertake alone.

Another type of combined research effort on oil production is that possible with private institutions; examples of such institutions in the Southwest are the Texas Research Foundation near Dallas, Southwest Research Institute near San Antonio, several research organizations affiliated with The University of Texas and A & M College of Texas, and others. These private research organizations operate in a fashion similar to patterns set by older and more established groups in other parts of the country. Private research groups of this type provide a means by which the smaller oil producing organizations can carry on effective research programs of their own. Research activities somewhat related to the above joint efforts are those consisting of grants and fellowships from operating companies to schools. Gaylord[1] has estimated that all branches of the oil industry provide at least 300 grants and fellowships for research work to schools at the present time, costing more than half a million dollars per year. This type of production research has the obvious advantage of training new scientists in the fields pertinent to oil production research, and of providing a reservoir of technically trained people that can join the other organizations listed above to engage in more immediate and larger programs of production research.

The fourth group of organizations concerned with research activities pertaining to oil production is that of the service and supply companies. The over-all magnitude of such research work is unknown to the writer, but, on its face, it must be exceedingly large. Most of us are familiar to some extent with the work being carried on continuously by service, supply, and manufacturing organizations on items or techniques in daily use in all producing operations. Examples of such activities are the work on drill bits, cementing methods and equipment, casing perforation techniques, well head designs, and a host of others.

The Author



Terry A. Pollard is the supervisor of production for Magnolia Petroleum Company at the field research laboratories near Dallas, Texas. He has had this position since March, 1947, when he left the Phillips Petroleum Company's employment as regional reservoir engineer at Houston.

He was born at Manor, Texas, and received a degree in geology in 1933 and a degree in mechanical engineering in 1934 from the University of Texas. After three years in petroleum and reservoir engineering work in West Texas for the Standard Oil Company of Texas, he served for a short time with Bahrein Petroleum Company in New York. Then, after about a year's work in reservoir engineering for the Standard Oil Company of California at Los Angeles, he attended MIT under the guidance of the chemical engineering department, where he was awarded a Master's degree in December, 1941.

He then returned to the Standard of California and was engaged in reservoir engineering work until 1943, when he joined the PAW. He is an active member of many professional and petroleum industry associations.

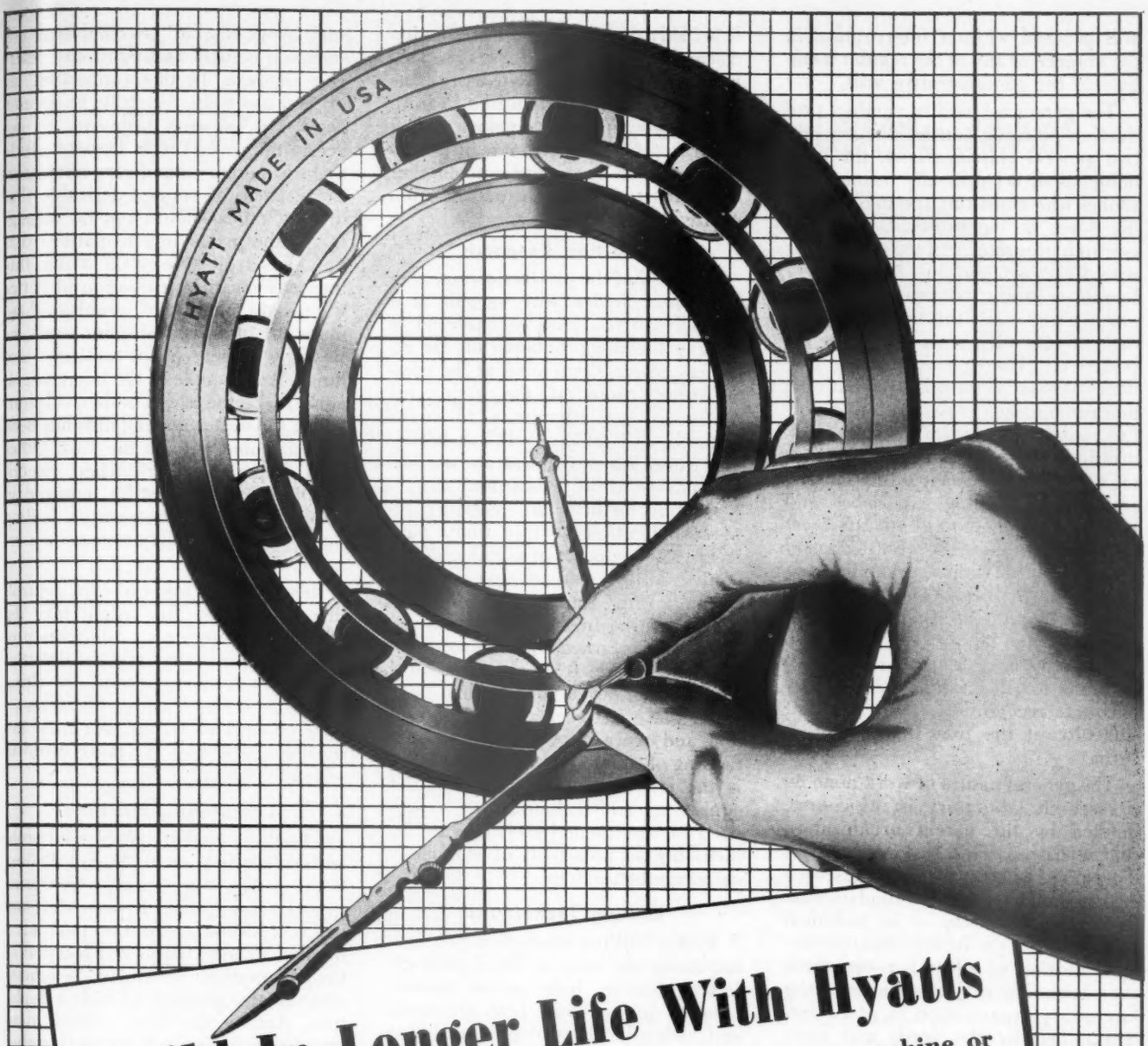
Organization for Research

There appears to be no one best way of organizing production research activities. Each of the four major agencies outlined above will doubtless have diverse requirements in this regard. Even within each group, several different types of organizations are being used effectively today.

Among the oil producing companies, production research is organized frequently as a parallel effort with exploration research in the same laboratory. This type of organization is well justified by the close relationship that exists between these two fields of activity and the close partnership that prevails between exploration and production operations in actual practice. The major objective of exploration research, is the development of new and better methods of finding crude oil and natural gas, while the major objective of production research is the development of new and better methods for getting crude oil and natural gas out of the ground once it has been found; but there are many overlapping fields of interest and many of the research tools that are used are common to both fields of study.

In such laboratories these two research activities constitute major organizational divisions. These two divisions can be divided further into sections, if desired, each covering some broad phase of the research program. In production research these might be, for example, drilling fluids, reservoir mechanics, and PVT studies. To complete the organization of such a laboratory, a third major organizational division is required to provide the necessary operating services for the two research divisions. These services will include the mechanical shops, the warehouse, the business and clerical offices, utilities, transportation, and any other miscellaneous operations necessary for the general maintenance of research facilities.

The minimum administrative staff required in a laboratory of this type is probably four people, comprising a director, who has the technical and managerial responsibility for the over-all operation of the laboratory, and three supervisors, each of whom has similar responsibilities in connection with the three major organizational divisions. Depending on the size of the laboratory, it may be desirable to augment this group with special staff assistants whose duties are defined by the particular needs at hand. It is also customary to designate auxiliary lines of authority so that the operations of the laboratory



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The personnel used to conduct production research can be divided into two general classifications: the technologists or scientifically trained personnel who constitute the major driving force in the prosecution of the research program; and the technicians who have not had the benefit of a formal scientific education and who are used to assist the technologist in the conduct of various research experiments. There is a growing tendency today to avoid conventional line management classifications below the rank of supervisor in a research division, and to classify technologists on a technical basis according to their professional training, experience, and merit. In this method of operations, it is proper to have several technical classifications, with overlapping salary ranges, to provide maximum flexibility in recognizing scientific achievements in the laboratory. It is also desirable to have a number of classifications for the technicians to allow adequate recognition of the levels of difficulty of the jobs that they perform.

The general nature of work done by a research laboratory is, of course, defined by the parent organization that sets it up. This basic assignment determines whether the major research efforts shall be placed on fundamental or applied research, or on technical service to the producing departments. The division of effort between these three possible major activities of a laboratory organization is, of course, determined by the needs and foresight of the particular management setting up the activity. Considerable emphasis is being placed at this time on the necessity for fundamental and applied research in the research laboratory itself, with the major part of technical service being handled by separate organizations either within or without the company.

Cost

The cost of conducting production research depends on the type of organization devised and the facilities that the research department may share with other departments. It is of interest to note that Gaylord[1] estimates an expenditure of 70 to 75 million dollars annually in all the research laboratories of the petroleum industry. He reports further that about 10,000 people are required in all these activities. Based on these estimates, it appears therefore that the cost of operating all phases of a petroleum research program is about $600 per month per man employed. It is likely that the costs of production research are near this average. This figure is of course exclusive of the capital expenditures required to initiate and maintain an adequate research program; furthermore, it will doubtless vary from one company to another according to the type of organization utilized.

Production Research

A review of the production research work now under way reveals that virtually all problems encountered in drilling for and producing oil are receiving research attention at the present time. Some of the major oil producers are attempting to cover virtually all fields by their own activities while others concentrate on certain phases of oil production.

Drilling methods are receiving research attention at this time, both from the standpoint of possible development of new methods and improvement of old. Among problems that need attention in the field of drilling are those concerned with marine drilling. Quite aside from the impressive engineering developments that have taken place in recent years on slant hole and overwater operations for the tapping of submerged reservoirs, there is the still more important field of equipment and techniques to be utilized for continental shelf operations, including the possibility of completely submerged structures.

Drilling Techniques

Rotary drilling research is proceeding along the lines of developing effective bottom hole prime movers (motors or engines) both electrical and hydraulic. It is to be hoped that some of these will prove to have wide application in the drilling industry. It would appear desirable for further work to be done on the problem of multiple deviated holes from one well bore. An effective development of this nature should have certain advantages in improving the productivity of wells in some types of reservoirs, and possibly increasing the ultimate recovery from some sands.

The research organization certainly cannot limit itself to ideas or techniques that may be characterized as "practical" under present conditions. Therefore, on the more fantastic side of drilling research, it would appear that some thought should be given to the application of shaped charges, rocket fuels, or other novel means of producing holes in the earth's crust.

Drilling Fluids

A second general field of production research, which needs considerable exploration, is that of drilling fluids. The broad limits within which such work should be contained are safe well control and minimum reservoir damage. In this connection, as oil and gas wells penetrate to greater depths, it becomes necessary to develop improved high density muds that have other satisfactory characteristics. It is, of course, desirable that drilling muds should not be damaging to the producing formations that they penetrate. Research along this line may mean investigation of better water-base muds, of emulsion-base muds, of improved oil-base muds, or possibly a search for entirely new fluids. An example of the latter might, perhaps, be the use of molten sulphur, which the writer understands has been experimented with in the past. Other such apparently far-fetched experimentation may hence be required in order to produce the types of drilling fluids that will satisfy tomorrow's requirements.

Research can assist also in controlling mud costs. This might take the form of evaluation of additives proposed for mud usage and the determination of relative benefits resulting from the use of various additives of different price. Other avenues are open for attack on the large problem of mud costs.

Completion Practices

Closely related to the research problems of drilling methods and drilling fluids is that of well completion practices. Over a period of years, alert and original thinking on the part of a number of individuals has resulted in the adaptation of many beneficial ideas to the problem of well completion. Among the more recent ideas are the technique of jet perforating and the newer technique of formation fracturing. Still more ideas are needed along these lines, and improved practices are desirable in the problem of completing wells in such a manner to obtain maximum productivity and maximum recovery.

One of the most fertile fields for production research and one in which the need is most urgent at the present time is that of reservoir flow, reservoir behavior, or perhaps just oil recovery. Basic to this is the need for research in the flow of fluids, both single-phase, which has been very well initiated in recent years, and in the field of multiphase flow and displacement of fluids from reservoirs containing more than one type of fluid. While excellent pioneer work has been done in this regard by a number of the industry's outstanding scientists, it is a sad fact that the amount of published data on multiphase flow behavior in porous rocks is very small, and the extent of the applicability of the published data

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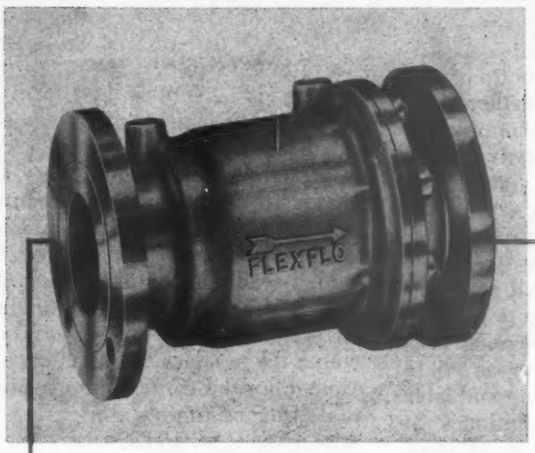

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is unknown. The probability is that such applications are quite limited. This problem of multiphase flow of fluids in oil reservoirs and the mechanism of displacement of petroleum from such reservoirs is tremendous in scope. It is probable that a fully comprehensive research activity on the order of a half million dollars per year is well justified, because the stakes are large and any real developments would result in tremendous benefits to the oil industry and to the public at large.

Core Analysis

Other research activity under way and on which additional emphasis can be imparted is that of core analysis methods and techniques. Improvements appear to be in order on the measurement of core properties that have been studied for a number of years. Occasionally, new core properties are found that appear to have significance in defining rock or reservoir characteristics. In particular, it seems pertinent to improve either interpretations or techniques to take into account the difference between laboratory conditions of core analysis and actual conditions in which core samples existed in the reservoir before being removed. The so-called restored state method of estimating interstitial water content, for example, is usually carried out at conditions that do not actually restore the sample to reservoir conditions.

Further research effort is needed on the problem of the accurate estimation of fluid saturations in oil reservoirs. This would include the determination of interstitial water, whether by core analysis or by other means, and the improved determination of the amounts of hydrocarbons in place. This might come about by the improvement of old methods or by the development of new methods of fluid content determination, and includes improvement in well logging methods and their interpretations, not only for fluid content determination, but for other purposes as well. It is encouraging to see some of the logging companies embarking on more intensive research, and it is hoped that these companies will go much further in taking their customers into their confidence regarding the meaning and interpretation of well logs than has been true in the past. Release of basic information by the service company will be of mutual benefit to the service company and its customer.

Model developments and model studies have progressed steadily in the last few years. There appears to be room for considerable research yet in making these models more flexible and more accurately reproductive of reservoir conditions. In this connection, the writer feels that the Carter Oil Company has contributed materially to the industry and to the public at large by making available at nominal cost the results of original work on the development of the unsteady state Carter analyzer for all those who care to utilize it.

Another field for effective research effort is that of the improvement of models referred to above or the development of new models and techniques for postulating reservoir performance. In particular, it seems desirable to develop methods that will forecast reservoir behavior much earlier in the life of the field so that such forecasts can play an effective part in formulating the final development program for the field as well as its future production program.

Still another aspect of oil production that can justify considerable research effort is the translation of laboratory data into useful field information. An example of such a need is the conversion of mud measurements and core data to bottom hole or reservoir conditions. Further clarification is needed for determining the meaning of interstitial water measurements. Of great economic significance is the need for improvement in the ability to determine oil productivity possibilities of formations in advance of testing. This would lead to better grounds for deciding when to test and when not to test various sands in a given well, particularly in areas where the wells are cased to bottom and later tested by perforation techniques at promising horizons. A constant additional need is for improvement in the ability to calculate oil and gas reserves accurately. This need covers a host of factors, any one of which might justify active prosecution as a research project on its own. Various other examples can be cited for the need of research on the translation of laboratory data into useful field information.

Secondary Recovery

A further large phase of research activity in the field of reservoir behavior is that of secondary recovery. On this problem there is plenty of room for the development of improved techniques and possible introduction of new methods of secondary recovery. The gains to be made in making more oil available by effective research in this field are obvious.

Another field for research activity is that connected with the properties of oil and gas. Work along this line in the past has been concentrated on the pressure-volume-temperature behavior of various mixtures of oil and gas. In the future, such work may take the trend of better instruments and methods for measuring the properties of hydrocarbon mixtures under reservoir conditions, for better definition of equilibrium and non-equilibrium behavior of such mixtures, and for the measurement of properties at extended pressure and temperature ranges. It is also possible that more attention will be paid to other properties of such hydrocarbon mixtures, which have received little attention in the past.

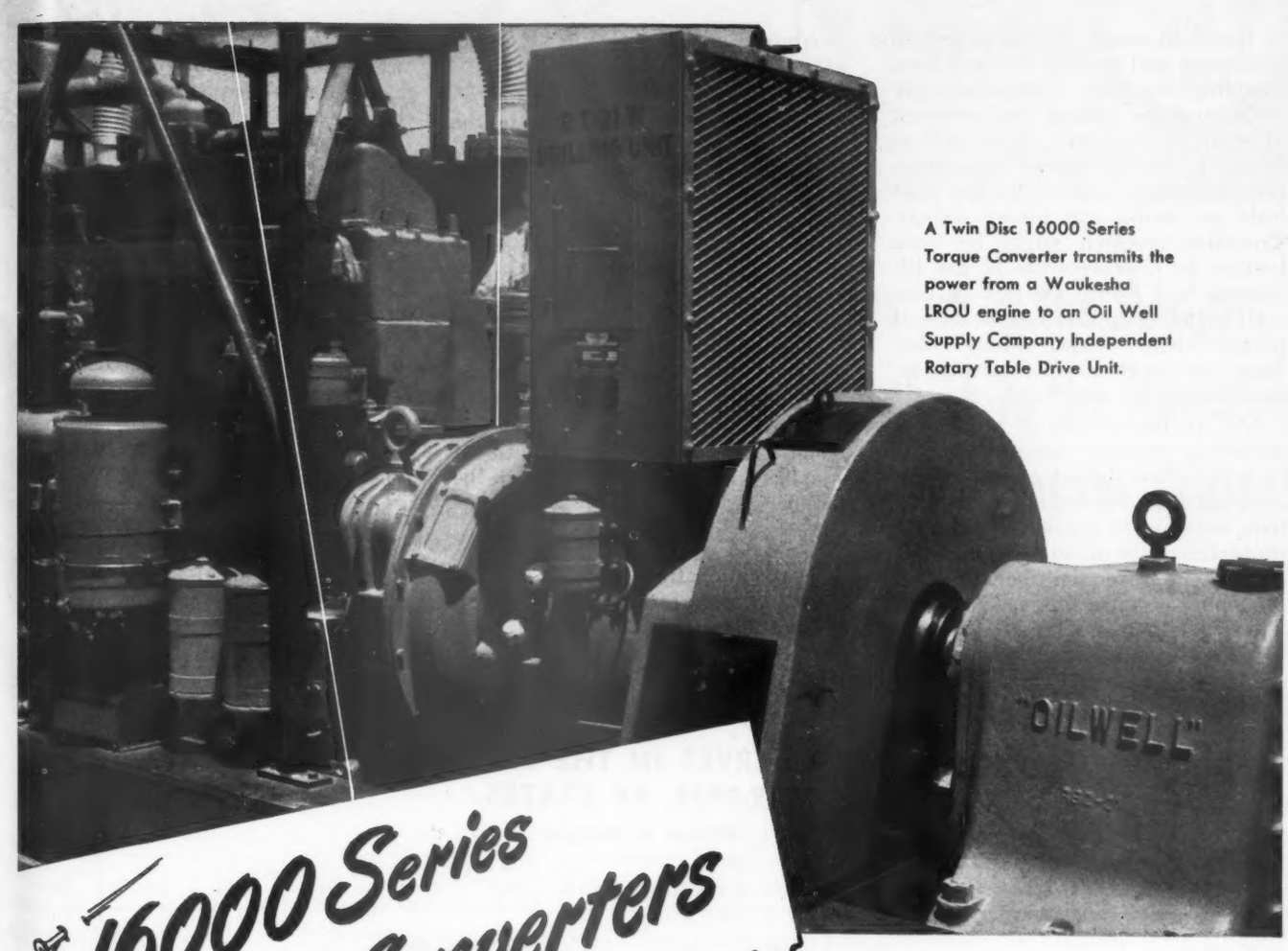
Instruments

There is room for improvement in the performance of instruments used in production, and for the invention and development of new instruments. One example of this is the subsurface pressure gauge, the improved accuracy of which is constantly sought. To those concerned with reservoir analysis, the advantages in being able to establish without question the exact reservoir pressure of a high permeability field within one psi are immediately obvious. More flexible subsurface gauges to perform a greater variety of functions in the drilling, completion, and production of oil wells, are constantly being demanded. The writer himself long has had a desire to see an accurate pressure instrument developed that could be installed permanently in a well, from which readings could be taken at any time at the surface. Such an instrument would have greater utility and value in modern producing operations than the commonly accepted installation of tubing and casing pressure gauges on wells.

On the more fantastic side in the field of production instruments, it is interesting to consider the value of and uses to which an instrument or technique might be put that could determine by direct detection from the surface, the nature and extent of flow patterns or drainage. It would obviously be of considerable importance and value to be able to determine the same thing with respect to water encroachment by measurements from the surface of the ground over the reservoir. Whether research could economically produce instruments or techniques to achieve these ends is problematical, but the usefulness of such developments is beyond question. We think of many other production instruments that would be helpful and economically beneficial in the production of oil.

Engineering Research

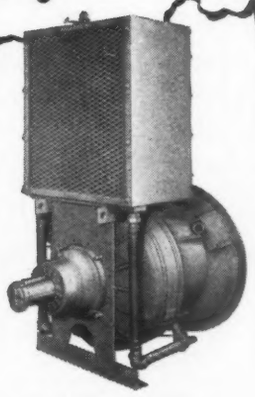
Another general aspect of production research activity might be classified as engineering research. Examples



A Twin Disc 16000 Series Torque Converter transmits the power from a Waukesha LROU engine to an Oil Well Supply Company Independent Rotary Table Drive Unit.

16000 Series Torque Converters

...for the 250—1000 hp Range

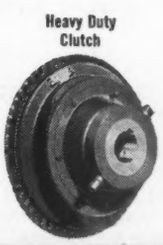


Twin Disc 16000 Series Torque Converter

Deep-hole drilling requires more power, and better power transmission equipment. That's why Twin Disc designed its 16000 Series Hydraulic Torque Converter—to meet the requirements of rigs using one or more engines in the 250 to 1000 hp class.

Like all Twin Disc Hydraulic Torque Converters, Series 16000 automatically and instantaneously selects the proper torque ratio for the load and the engine power . . . permits uninterrupted acceleration to a maximum speed and an efficient handling of the load . . . cushions all shock loads and torsional vibrations . . . leaves no gear shifting or guesswork to the operator.

The complete line of Twin Disc Hydraulic Torque Converters (Lysholm-Smith type) include three series; 10000, 11500, and 16000 . . . applicable to engines with horsepower ratings of from 40 to 1000 hp. For complete information, write the Hydraulic Division for Bulletin 135-C or Bulletin D-430 which refers specifically to the 16000 Series Converters. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Ill.).



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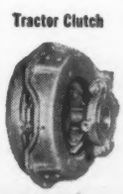

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

in this field would include improved equipment and methods for well head sampling, especially from condensate wells, and the general improvement of equipment on many items such as tubing joints and thread compounds for minimizing joint friction and joint leaks in casing and tubing strings. Profitable research might be done looking to improvements in gas lift systems and lifting systems in general, including applications of oil well pumps where needed. Many other items pertinent to engineering research could be mentioned.

Still another aspect of production attracting research attention at the present time is that of gas-oil separation and field processing. The objectives here are to retain the desirable properties of the oil and gas produced and to improve the methods and economics of extracting special products in field plants. This work is sometimes not classified as production research, but is carried on under other headings in the activities of a research organization.

A final category of production research not covered specifically by the preceding summary is that of brand new ideas—ideas that we do not even suspect at the present time. These may take the form of adaptations from other fields of endeavor, or they may be original to the oil industry itself. The industry will make no mistake in betting its dollars on the efforts of competent research scientists to produce new ideas that will mean better profits from, or better economics of, oil producing operations, and that will result in the availability of additional supplies of crude petroleum for the nation.

Justification

A quotation from a recent issue of *Chemical Engineering News* is appropriate for closing this article. This quotation should be of particular interest to those who handle the purse strings of their companies or those who will do so in the future.

"Research is expensive, but nobody has invented a cheaper way to stay in business."

Acknowledgements

The writer wishes to acknowledge the courtesy of the Management of Magnolia Petroleum Company for permission to prepare and publish his views of the purpose, manner, and problems of production research in this article.

Acknowledgement is made to Mr. Carl Young and the API Division of Production Staff for data kindly furnished by them on research activities of the American Petroleum Institute.

Acknowledgement is made to Mr. E. G. Gaylord for the use of information contained in his paper presented to the American Petroleum Institute in Chicago in November, 1948, entitled "The Role of Research in the Production of Oil."

* * *

ESTIMATES OF PROVED OIL RESERVES IN THE UNITED STATES ON JANUARY 1, 1939-1948, BY STATES

(Millions of Barrels)

	1939	1940	1941	1942	1943	1944	1945	1946	1947*	1948*
Eastern States:										
Illinois	243	382	315	334	307	295	321	349	351	355
Indiana	6	14	14	23	32	31	31	41	44	46
Kentucky	38	44	41	36	35	35	41	57	59	65
Michigan	43	51	35	56	64	55	65	64	69	70
New York	41	35	65	60	54	90	86	81	76	71
Ohio	26	32	30	37	35	33	32	30	29	29
Pennsylvania	200	183	188	171	153	137	123	111	98	123
West Virginia	24	46	53	50	47	44	41	39	36	36
Total	621	787	741	767	727	720	740	772	762	795
Central and Southern States:										
Arkansas	188	320	306	295	300	297	293	304	267	297
Kansas	613	726	692	690	687	646	602	542	545	563
Louisiana	1,040	1,173	1,216	1,330	1,442	1,484	1,573	1,690	1,652	1,791
Mississippi	0	7	40	80	41	39	209	267	270	304
New Mexico	703	687	692	675	677	654	563	512	544	530
Oklahoma	1,162	1,063	1,002	1,036	969	909	970	890	898	953
Texas	9,448	9,768	10,624	10,976	11,546	11,325	11,375	11,470	11,647	11,778
Total	13,154	13,744	14,572	15,082	15,662	15,354	15,585	15,675	15,823	16,216
Mountain States:										
Colorado	18	20	23	23	39	45	89	260	300	382
Montana	105	94	89	86	86	108	112	108	104	115
Wyoming	261	306	305	304	371	499	582	600	589	679
Total	384	420	417	413	496	652	783	968	993	1,176
Pacific Coast States:										
California, Total	3,189	3,532	3,291	3,323	3,196	3,337	3,344	3,410	3,294	3,295
Other States	0	0	4	4	2	1	1	2	2	6
Total United States	17,348	18,483	19,025	19,589	20,083	20,064	20,453	20,827	20,874	21,488

*For January 1, 1947 and 1948 condensate is not included; for comparison the 1946 United States total excluding condensate was 19,942 million barrels.

Note: From reports of Committee on Petroleum Reserves, American Petroleum Institute, of the amount of crude oil that may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations. The change in reserves during any year represents total new discoveries, extensions, and revisions, minus production.

Source: U. S. Bureau of Mines and American Petroleum Institute.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

Baash-Ross News

BAASH-ROSS TOOL COMPANY · LOS ANGELES · HOUSTON · NEW YORK

OUR 29th YEAR

You can **See** it in the Design!
Feel it in the Handling!
Check it on the Scales!

BAASH-ROSS "DU" ROTARY SLIPS ARE UNUSUALLY LIGHT WEIGHT

. and Light Weight is only ONE of *many* "DU" advantages!

Stop and think how many dozens of times the rotary slips are ted by the drilling crew during a *single* round trip. Multiply this repeated day-after-day, month-after-month operations and you readily appreciate why light weight is such an important factor look for in rotary slips. *And you really get light weight in ash-Ross "DU" Rotary Slips!*

For example, check these figures on typical sizes of "DU" ips...

Size of "DU" Rotary Slips	"DU" Regular (12" long)	"DU" Long (16" long)
½" O.D. Slips with 4½" Liners	137 lbs.	158 lbs.
⅝" O.D. Slips with 5⅝" Liners	146 lbs.	177 lbs.
" O.D. Slips with 7" Liners	154 lbs.	196 lbs.

On these and other sizes you'll find Baash-Ross "DU" Rotary Slips are pounds lighter because all excess metal has been removed without in any way sacrificing strength or ruggedness. *Notice the deeply-cored backs that replace dead metal with a cellular rib construction that combines more-than-ample strength with minimum weight.*

▶ But most important is the fact that unusually light weight is only *one* of many important advancements you get in Baash-Ross "DU" Rotary Slips. Carefully check through the features outlined below... compare them right down the line with *any other* make of slips... and you'll see why "DU" Rotary Slips are today's outstanding buy for maximum convenience, safety and all-around economy!

Baash-Ross "DU" Rotary Slips are available in both "Regular" length (12" long—for wells through 8000 ft. in depth)... and "Long" length (16" long—for the deepest wells and heaviest drill strings). For full details, see your nearest Baash-Ross representative—or write direct!

WHAT OTHER SLIPS COMBINE SO MANY OUTSTANDING ADVANTAGES?

▶ **3 BODY SIZES FIT 14 PIPE SIZES:** With "DU" Slips you don't need a separate slip for each size of drill pipe. By simply changing the liners—a quick inexpensive operation—*three* basic "DU" body sizes fit *all* sizes of tubing, drill pipe and casing from 2⅜" O.D. through 7" O.D. Cuts slip investment and maintenance to a minimum!

▶ **MONEY-SAVING SEGMENTED LINERS:** "DU" Slip Liners are in 4" segments instead of single long units. If you use both 12" and 16" Slips there's no need to stock liners for both sizes. Simply keep a supply of 4" segments on hand—*three* 4" segments for 12" Slips... *four* 4" segments for 16" Slips... thus greatly reducing inventory costs.

Also, if for any reason slip wear is concentrated at one point, liner segments can be switched or inverted to distribute wear without replacing any parts. Or if too worn, replace only the worn segments and use the others for additional service. Cuts maintenance costs to the bone!

▶ **SELF-ALIGNING HINGE:** "DU" Body Segments are not merely hinged together, but are unitized by a unique "floating" hinge that prevents *vertical* misalignment, yet permits them to adjust *laterally* to any irregularities in bore of master bushing. This assures a full, uniform grip under all conditions!

▶ **SAFETY LINER RETENTION:** "DU" Slips are so designed that *all* stresses—both of supporting the pipe and of breaking out joints—are transmitted directly from the liners to the slip body. There are no retaining bolts or pins to become sheared and allow liners to fall into hole. Yet liner segments can be quickly removed by simply pulling a cotter and sliding out one keystone retaining key. This double keystone key firmly mates liners and body into single rigid unit!

▶ **AND OTHER ADVANTAGES:** There are still other vital "DU" advantages... the safety loops on the handles that safeguard crew's hands against injury... the polished backs that eliminate sticking in the bore... the perfected grip design that will not damage the pipe... the flattened toes that enable "DU" Slips to stand solidly on table or floor... and many other unique features.

BEFORE YOU BUY ANY ROTARY SLIPS GET THE COMPLETE STORY ON "DU" ALL-AROUND SUPERIORITY!

FOREIGN OIL FIELD DEVELOPMENT DATA

(For six months ending June 30, 1948)

	Canada (Province of Alberta)						
1 Country							
2 Name of company	The California Standard Company						All companies†
3 Name of field	Bantry	North Princess	Conrad	East Taber	West Taber	South Princess	Turner Valley
4 Year of discovery	1947	1944	1944	1942	1945	1946	1914
5 Footage drilled, 6 mo.	0	0	0	0	16,935	0	48,424
6 Wells completed, 6 mo.							
(a) Oil	0	0	0	0	4	0	2
(b) Gas	0	0	0	0	0	0	0
(c) Dry	0	0	0	0	1	0	2
7 Wells drilling*	0	0	0	0	0	0	6
8 Drilling wells suspended*	0	0	1	0	1	0	0
9 Flowing wells*	1	3	0	0	2	2	277
10 Pumping wells*	0	0	16	6	10	1	0
11 Other artificial lift wells*	0	1	0	0	0	1	2
12 Oil wells shut in*	0	0	0	1-inject. well for gas	1	0	16
13 Producing depths, ft*	3300	3900	3120	3200	3200	3300	6200–8500
14 Crude oil produced, 6 mo., U.S. bbl	8030	31,155	89,496	78,870	121,648	11,243	2,551,359△
15 Average crude production, June, U. S. bbl per day	60	170	470	230	360	125	12,377△
16 Cum. crude prod., U. S. bbl	8030	191,528	645,371	581,765	310,287	33,000	95,502,527△
17 Base of crude	Asphaltic	Mixed	Asphaltic	Asphaltic	Asphaltic	Asphaltic	Mixed
18 Gravity of crude, deg API	24	35	23	18	23	24	40–50
19 Name, age, and type of producing formation	"Sunburst," Lower Cretaceous, Sand	Jefferson, Upper Devonian, Dolomite	Basal Ellis (Sawtooth) Jurassic, Sand	Taber-Cutbank, Lower Cretaceous, Sand	Taber-Cutbank, Lower Cretaceous, Sand	Madison, Mississippian, Limestone	Madison, Carboniferous Limestone

	Canada			Peru	Colombia	Venezuela		
1								
2	Imperial Oil Ltd. and Others	Imperial Oil Ltd.		International Petroleum Company, Ltd.	Tropical Oil Company	Creole Petroleum Corporation‡		
3	Leduc-Woodbent (Alberta)	Norman Wells (N.W.T.)	Becher (Ontario)●	La Brea-Parinas Estate	De Mares Concession	Bolivar Coastal Fields	Cumarebo	Jusepin
4	1947	1932	1946	1875	1918	1917	1931	1938
5	381,892	0	10,665	253,192	0	..	..	..
6a	50	0	3	39	0	80	0	6
b	0	0	1	1	0	0	0	0
c	5	0	3	22	0	0	0	2
7	40	0	0	15	0	8	0	0
8	0	0	0	8	0	..	..	..
9	79	16	13	199	8	639	9	334
10	1	0	1	1961	940	346	12	2
11	0	0	0	2	1	46	0	0
12	5	51	2	0	0	313	89	86
13	4600–5400	1060–1986	1800–1900	500–7000	500–4000	1200–6000	600–2100	3000–5300
14	1,283,467	190,175	25,784	5,440,000	3,500,000	86,168,000	884,000	7,722,000
15	13,294	1,249	155	30,300	29,300	487,200	4,230	42,200
16	1,655,894	2,654,910	48,396	294,100,000	370,100,000	1,419,552,000	38,865,000	100,122,000
17	Paraffinic	Mixed	Paraffinic	Mixed	Mixed	Asphaltic	Paraffinic	Mixed
18	39	39–41.5	38.8	H.C.T.–37.5 L.C.T.–34.8	24.5	12–31.8	42–56	22–35
19	Dolomite, Devonian	Limestone, Devonian	Salina Guelph, Silurian	Verdun, Talara, Parinas, Pale Greda, Salina; Eocene; Sands	Colorado, Mugrosa; Oligocene; Sands. La Paz, Upper Eocene, Sands	Miocene, Eocene; Monocline	Miocene; Faulted Anticline	

	Venezuela (continued)							
1								
2	Creole Petroleum Corporation‡ (continued)							
3	Mulata	Pedernales	Pilon	Quiriquire	Roble	San Joaquin	Temblador	Uracoa-Tabasca
4	1941	1933	1936	1928	1939	1939	1936	1937
5	..	..	..	..	..	..	..	..
6a	8	0	2	32	1	3	7	0
b	0	0	0	0	0	0	0	0
c	1	0	0	2	0	0	5	0
7	0	0	0	6	3	2	2	1
8	..	..	..	..	..	..	..	..
9	167	2	0	84	15	34	75	0
10	5	0	0	229	0	0	0	0
11	2	0	0	0	0	0	0	0
12	51	11	5	67	1	12	16	2
13	3500–6660	1380–1920	3370–3530	690–5100	8040–10,600	4830–7480	3310–4500	4290–4380
14	4,097,000	452,000	..	11,773,000	856,000	1,982,000	1,611,000	0
15	20,900	2,430	..	67,730	5,330	11,170	9,570	0
16	41,542,000	9,928,000	..	290,329,000	14,318,000	23,565,000	26,471,000	46,000
17	Mixed	Asphaltic	Asphaltic	Asphaltic	Paraffinic	Paraffinic	Asphaltic	Asphaltic
18	21–38	19–23	14	12–28	42–60	37–50	18–27	15
19	Miocene; Faulted Anticline		Miocene; Anticline	Pliocene, Oligocene; Shoreline	Miocene, Oligocene; Terrace	Miocene, Oligocene; Faulted Anticline	Miocene, Oligocene; Fault	

FIELDS INACTIVE OR ABANDONED

	Venezuela								
1 Country									
2 Name of company	Creole Petroleum Corporation								
3 Name of field	Capacho	Los Olias	Las Palmas	Orocual	Socororo	Totumo+	Los Barrosos	Misoa	Monte Claro
4 Year of discovery	1945	1942	1928	1933	1940	1914	1922	1921	1926
5 Oil wells inactive	1	1	9	3	1		All Abandoned		
6 Producing depths, ft.	4400–4500	7300–7400	2100–5400	2600–3190	4000–4020	1550–3100		Abandoned	
7 Cum. crude prod., U. S. bbl	7000	5000	381,000	30,000	12,000	149,000	96,000	8,000	11,000
8 Base of crude	Asphaltic	Paraffinic	Paraffinic	Asphaltic	Mixed	Asphaltic	Asphaltic	Asphaltic	Paraffinic
9 Gravity of crude, deg API	23.1	46	33	13	27	20	16–22	15	35
10 Age and type of formation	Oligocene; Faulted Anticline	Miocene; Faulted Anticline	Miocene, Oligocene; Anticline	Miocene, Pliocene; Shoreline	Miocene, Oligocene; Faulted Anticline	Igneous Fault Zone	Eocene; Anticline		Miocene, Oligocene; Monocline

*At end of period.
†As reported by Imperial Oil Ltd.
△Includes absorption.
●Other Imperial Oil Ltd. operated fields in Ontario at depths from 330 ft to 1180 ft produced 2494 bbl during the period and gave a cumulative production to June 30, 1948 of 3117 bbl.
‡For the active fields in which this company operates, the term "wells shut in" includes closed in and inactive wells.
+Now held by Venezuelan government as part of the national reserve.

SOUTHWEST

A NEW SLUSH PUMP PISTON WITH SNAP BACK ACTION

Gets the right rubber for the job from Murray!

The Southwest PISTON features a patented operating principle in which the rubber lip of the piston snaps free from the liner at the end of the pressure stroke. Thus, the rubber lip of The Southwest Piston flexes or bends thousands of times during a normal day's operation . . . millions of times during a normal service life.

Murray engineers, working with The Southwest Company, developed the right rubber for this job as they have for many other oil equipment manufacturers with difficult rubber compounding and molding problems. We invite you to bring *your* rubber problems to Murray for a prompt and economical solution. We specialize in the production of rubber—natural and synthetic—for the oil industry.

MURRAY RUBBER CO.
HOUSTON, TEXAS

Murray Rubber

All-Welded Design Reduces Weight of Slush Pump for Portable Drilling Rig

By R. L. LOONEY*

As a means of improving product performance while reducing manufacturing costs, the replacement of castings with welded steel fabrication is becoming increasingly important to the manufacturers of machinery in all fields of business and industry. In the oil, gas, and water drilling field, one company** has recently redesigned for welded construction a 4½-in. by 5-in. slush pump for mounting on a portable rig.† The pump now weighs 650 lb as compared with the 1475 lb weight of the cast iron design.

Welded design has effected a 56 per cent reduction in weight and a corresponding reduction in size, both of which are of major importance to the effectiveness and portability of rig.

The complete pump as redesigned is seen in Fig. 1. Castings are replaced with SAE 1020 hot rolled steel and SAE 1020 cold drawn seamless tubing. The pump is designed for a maximum operating pressure of 4000 psi. The calculated maximum stress used in the design is 7000 psi, allowing a safety factor of about four to one.

The power end of the pump, Figs. 2 and 3, is made from 3/16-in. side plates and 3/16-in. crosshead sleeves. The plates are torch cut to shape and ground smooth. The two sides and crosshead liner retainer walls are completed first as sub-assemblies by welding in bracing and sleeves, and then assembling and finish welding.

All welds in this assembly are corner and fillet welds for which no edge preparation is necessary. The ¼-in. and ⅜-in. single bead welds are made with a ⅛-in. diam electrode*. The side and wall assembly is then placed in a final assembly jig and the cover sheet, rod cavity bottom, mud end plates, and gear box bottom are added.

The mud end (Fig. 4) presents a more complicated fabrication problem due to the complexity of the sizes and shapes that have to be assembled. For manufacturing, the mud end is broken down into four sub-assemblies (shown in Fig. 5): (a) discharge suc-

*Mr. Looney is district manager at 2750 Sand Spring Road, Tulsa 1, Oklahoma, of The Lincoln Electric Company, Cleveland 1, Ohio.

**The George E. Failing Supply Company of Enid, Oklahoma.

†No. 750 Sizmo Holemaster.

*"Fleetweld No. 5."

EXCLUSIVE

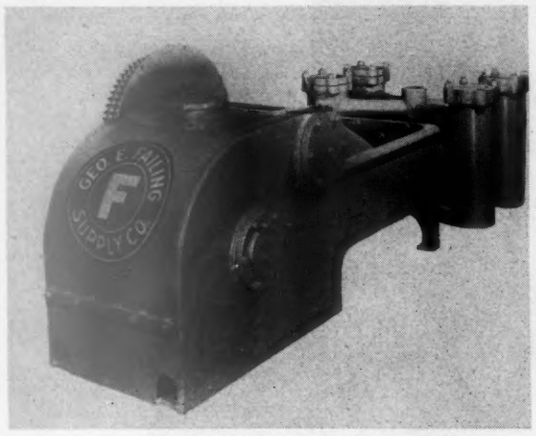

Fig. 1. A 56 per cent reduction in weight is achieved in manufacturing this 4½-in. by 5-in. pump with welded steel instead of cast iron.

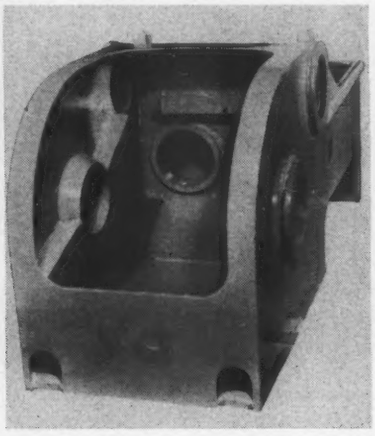

Fig. 2. Power end case of pump is fabricated from 3/16-in. plates and 3/16-in. crosshead sleeves.

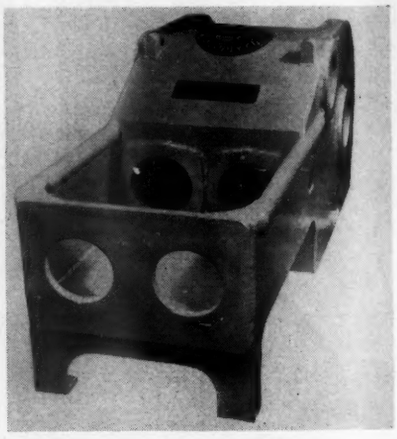

Fig. 3. All welds in the power end are corner and fillet welds. No edge preparation is required.

Fig. 4. Left, mud end of pump is made from seamless tubing and formed sheet, which is welded first into form sub-assemblies.

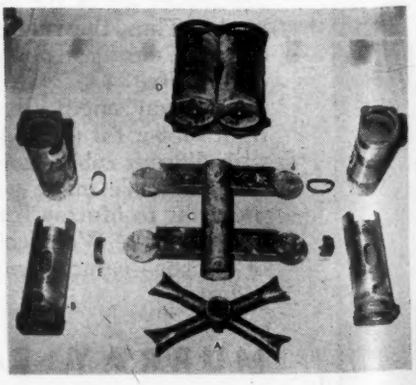

Fig. 5. Mud end sub-assemblies: (A) discharge suction; (B) valve chambers; (C) suction assembly; (D) cylinder assembly. Parts marked (E) are connection tubes.

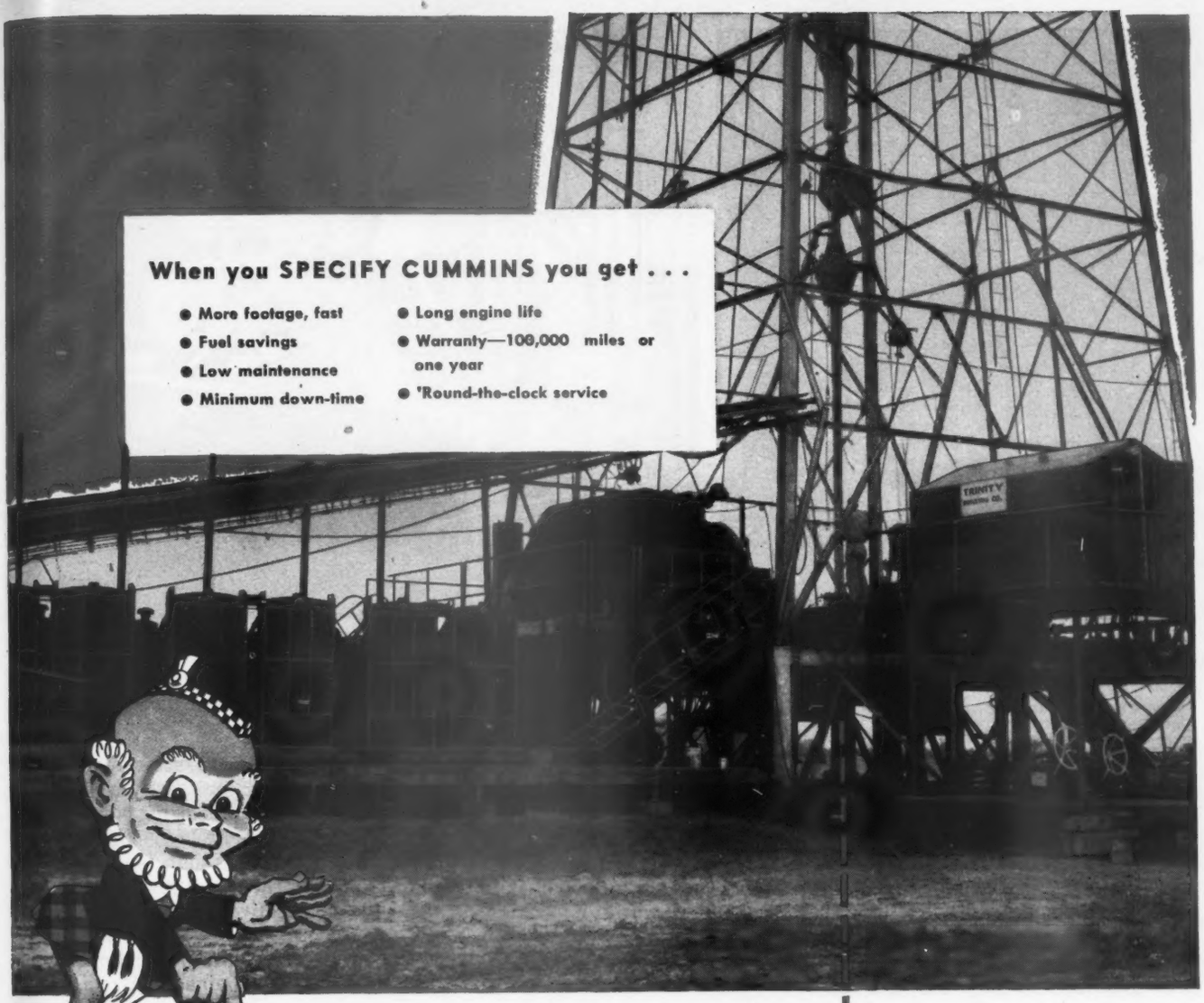
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Fig. 6. Welding the mud end sub-assemblies as arranged in the master jig.

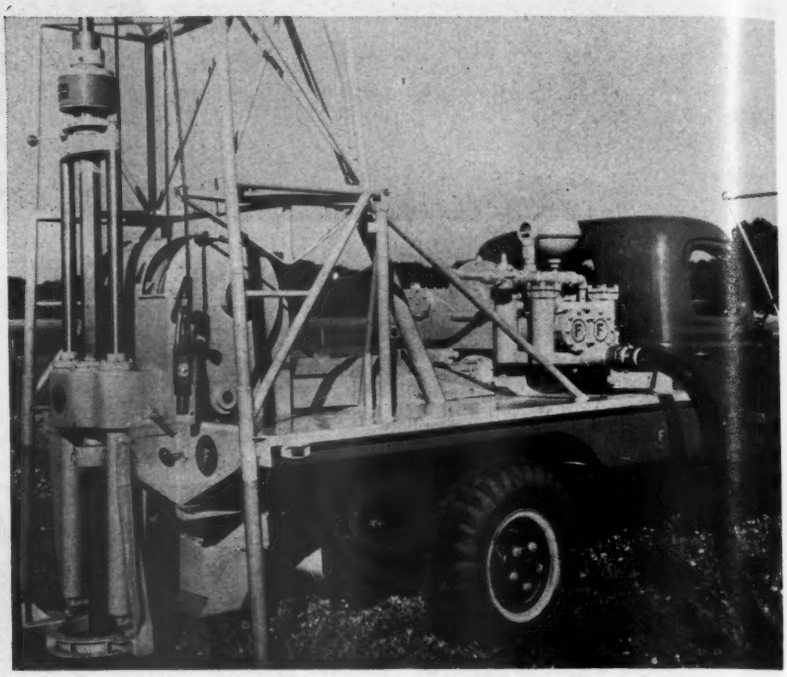


Fig. 7. Shot hole and core drilling rig carrying the 4½-in. by 5-in. welded slush pump.

tion; (b) valve chambers; (c) suction assembly; and (d) cylinder assembly. The pieces marked E in Fig. 5 are connection tubes. These individual units are fabricated in separate jigs, then assembled in a master jig.

The square suction tubes are sheared and formed from ⅛-in. sheet. Corners are butted and welded. All valve chambers and liner sleeves are 3/16-in. wall seamless tubing. The valve chamber flanges are flame cut from ⅞-in. plate. Both the liner sleeves and the flanges are machined for fit, a J groove being provided for welding liner sleeves in valve chambers and cylinder barrels. The valve chamber tubing is faced and beveled with a double vee for joining the flanges. Flanges are welded to the valve chambers both inside and out.

Complete penetration is obtained on all welds that are subjected to pressure. Beads are ¼-in. and ⅜-in. single and multiple pass, depending on the edge preparation of the joint. A ⅛-in. electrode* is used. Fig. 6 shows the sub-assemblies as they are arranged in the master assembly jig for welding.

After final welding the assembled power end and mud end are stress-relieved in a normalizing furnace. The complete pump as mounted on a shot hole and core drilling rig is illustrated in Fig. 7.

*"Fleetweld No. 5."

In addition to achieving size and weight reductions through welded design, the manufacturing company** is also appreciably reducing manufacturing costs through both direct and indirect savings. Previous difficulties with defective castings, such as sand holes, surface blemishes and uneven metal distribution in cylinder walls, have been eliminated. By discarding castings and patterns, which always restrict a designer's freedom to make changes, the manufacturer is also finding that a continuous program of product improvement and cost reduction can be more readily maintained.

**George E. Failing Supply Company.

* * *

How to Prevent Rods Breaking in Producing Well

THE problem of breaking rods in a producing well, generally remedied by pumping at the speed that produces the least amount of vibration, was recently solved in a far different manner by Glenn P. Nye of the Glenn P. Nye Drilling Company of Hays, Kansas. Nye not only remedied this proposition but practically eliminated the breaking of the rods.

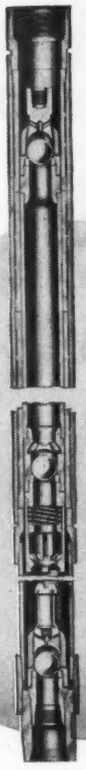
The well on which his idea was tried out was a 3600-ft well in the Hays field. Three inch tubing was used in the well with ⅞-in. rods. With almost uncanny regularity, the rods were breaking somewhere in the top 500 feet. The well was operated at a constant speed 24 hr a day and once every fourteen or fifteen days a rod would break because of vibration weakening the tensile strength of the metal rods in that 500-ft area. The broken rods upon being taken out showed no signs of corrosion. It was purely and simply a case of weakening of the rods by vibration.

Nye got the idea of using rod guides such as are used on the top of insert pumps to make the rods run straight up and down when a small pump is used on large tubing. He secured some of these guides of the size used with 3-in. tubing and installed them on every third rod, putting them between two adjoining rods, in the 500-ft zone where the breakage was taking place. He used six guides in this area, placing them about every 75 ft. The well then was put back into production and no breakage occurred for three months, after which one of the rods broke. This was such an improvement over the biweekly breakage period previously experienced that Nye believed the addition of a few more rod guides in the bothersome area would completely eliminate the trouble.

So when this breakage occurred after a three months period of 24 hr daily running, the broken rod was replaced and rod guides were installed on every other rod for the entire 500-ft zone. This eliminated the breakage by eliminating vibration in that area.—R.R.V.

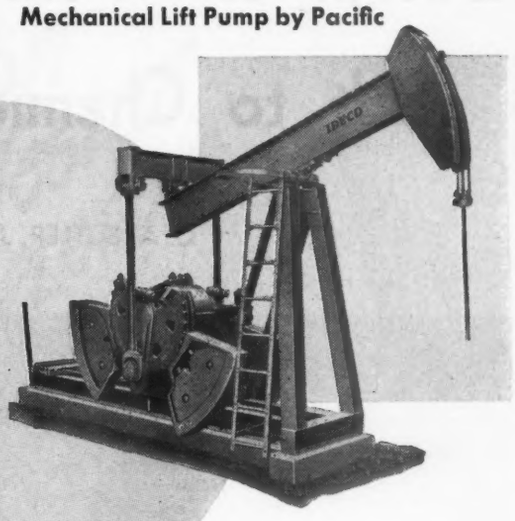
HYDRAULIC?

Hydraulic Free-Type Pump by Kobe



MECHANICAL?

Mechanical Lift Pump by Pacific



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Because all wells are different, no one type of pumping equipment will serve every well best.

Your well may pay off best with the Kobe Free-Type hydraulic pump or it may pay off best with the Pacific mechanical lift pump. How can you know unless you investigate both from impartial salesmen? In engineering there are always areas where types of equipment overlap. A decision has to be made. You need unprejudiced engineering at this point, not persuasion in favor of the one type which a salesman has to sell.

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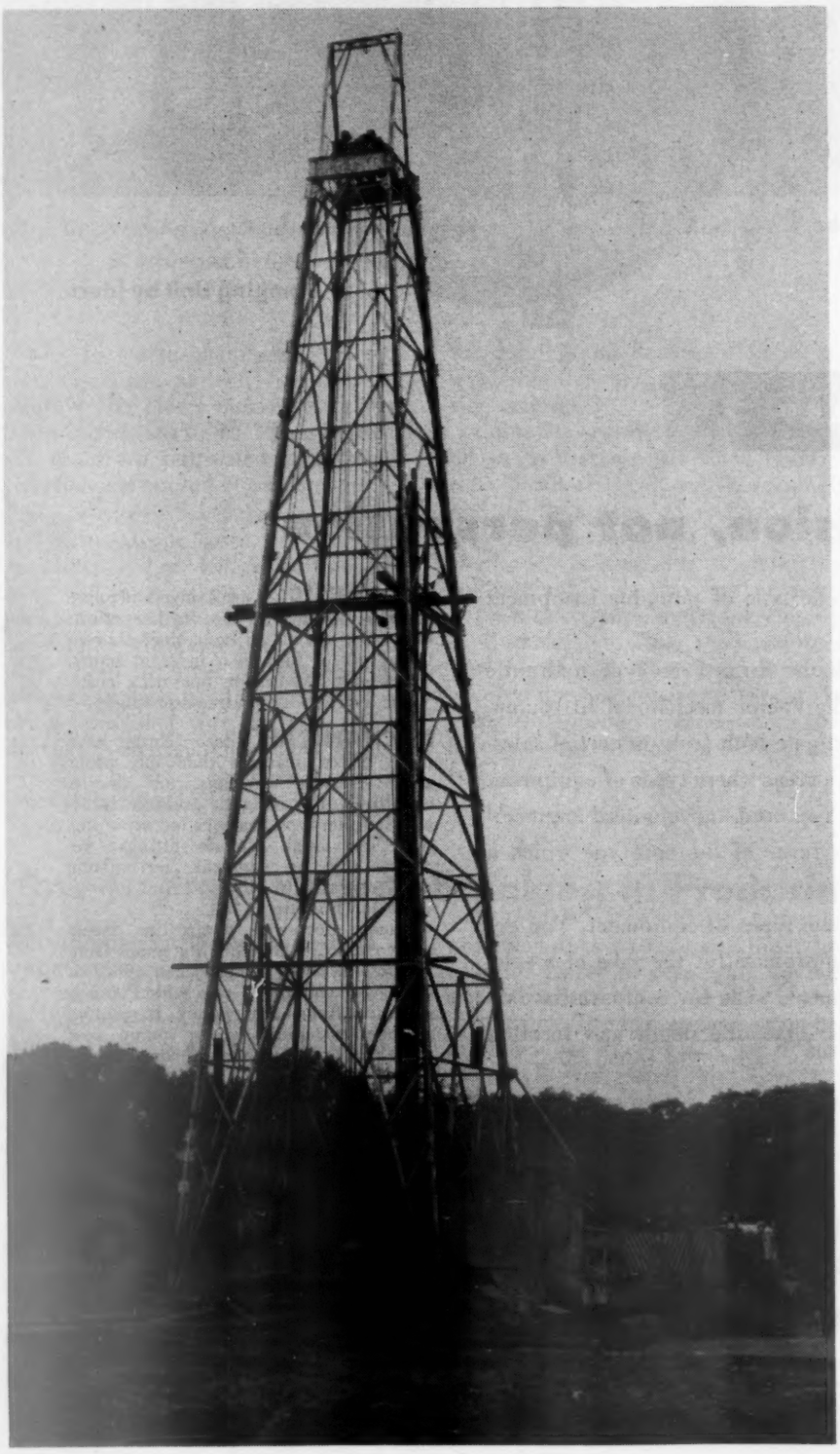
EXCLUSIVE

Design of Wells to Supply Salt to Chemical Plants

C. A. BUTLER, JR.*



Completing Diamond Alkali Well No. 2, Barbers Hill.

ECONOMICS governing the manufacture of almost any product dictate, among other basic requirements, an abundance of and accessibility to the raw material from which that product is to be fabricated or processed.

For example, in refining petroleum and its many products, the production "lifeline" depends on a continuous and adequate supply of crude. Similarly, the electrolytic production of liquid chlorine and caustic soda—two of mankind's most essential and versatile chemicals — depends on the proximity of an ample supply of sodium chloride.

An abundant and economically accesible supply of high-quality raw brine ranked highly on the list of reasons why one of the nation's major producers of heavy chemicals† decided to build its newest and second largest chlorine-caustic soda plant on the Houston Ship Channel at Pasadena, Texas, 25 miles from Houston. Raw brine to supply the plant's salt requirements is received via a 10-in. cast-iron pipeline from a salt dome at Barbers Hill, 17 miles from point of use.

From the design, engineering, and operating standpoints, the wells drilled for supplying sodium chloride should be of considerable interest to many petroleum engineers. The problems faced in drilling, operating, and maintaining the salt wells at Barbers Hill are similar in many respects to those encountered in oil wells making salt water.

▸ **Production, utilization, and value of salt.** Sodium chloride, known as "common salt" to the layman, occurs in solution in sea water and in natural brines, such as those encountered in oil field operations. In certain localities, sodium choloride is also found in sedimentary beds of various thicknesses.

Compared with other minerals, common salt is soft, has a low melting point, and is subject to plastic flow under temperature and pressure. Due to these characteristics, great salt plugs have been forced up from considerable depths, forming the huge salt domes, or buried pillars of salt, found in the Gulf Coast area and certain other sections of the country. These salt domes are ideal sources for sodium chloride.

*Director of Engineering, Diamond Alkali Company, Cleveland, Ohio.

MEMO TO:

Johnston Formation Tester

OWNERS and OPERATORS

By unitizing a Johnston "SHOOT-N-TEST" Gun Perforator with your regular Johnston Formation Tester Assembly, any designated formation can be both perforated and tested in one round trip of tubing or drill pipe. The "SHOOT-N-TEST" Gun Perforator is easily connected to Johnston test equipment for combined Perforation and Test operations. Simple top-hole manipulation of the string by the driller prepares the Gun Perforator for firing -- existing hydrostatic pressure in the well trips the firing mechanism.

The Johnston "SHOOT-N-TEST" Gun Perforator has the versatility to be used solely as a casing perforator or as the perforating unit in combined perforation and test operations. Its design embodies many advanced features to make it the ideal choice for operators desiring the utmost safety and efficiency in perforation equipment.

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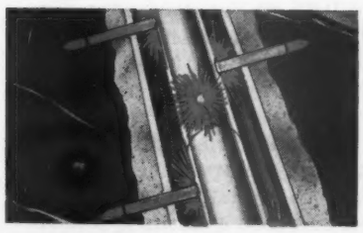

Fully patented—covered by Patent Nos. 2,073,107, 2,189,919, 2,126,641, 2,129,216, 1,901,813, 2,161,233, 2,176,766, 2,218,988, 2,186,488, 2,307,360, 2,305,139, 2,295,634

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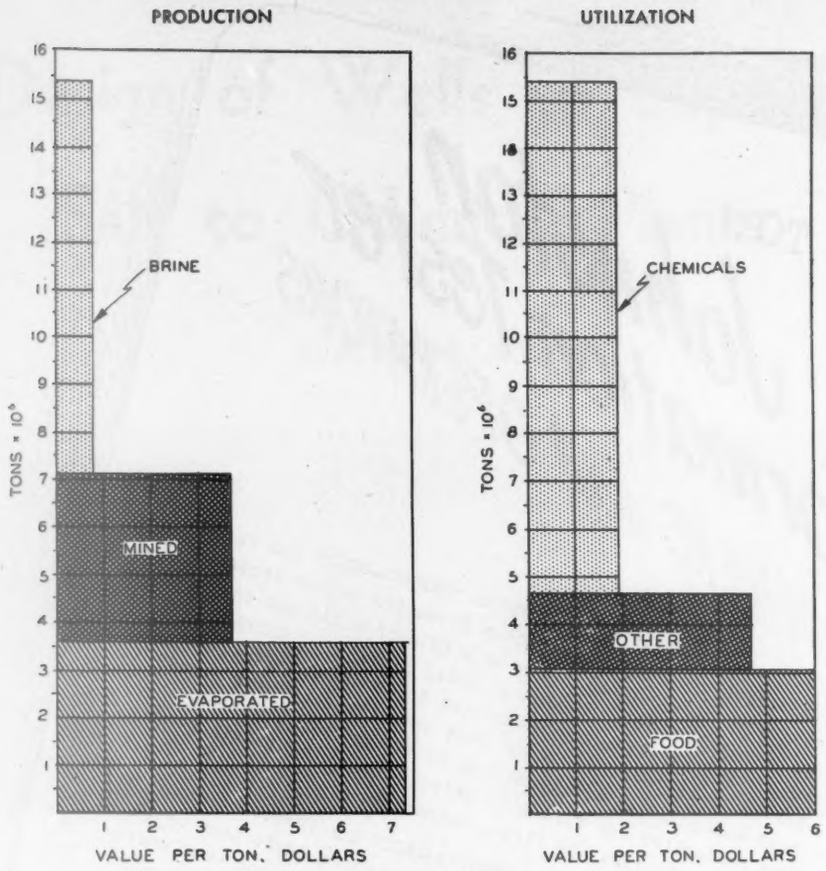


FIG. 1. Salt for year 1945.

Importance of sodium chloride to mankind and the honorable — even enviable — position this mineral has occupied for centuries in world commerce is recognized generally. Its importance is not confined to the chemical industries; but, in comparatively recent times, usage of salt in the processing and production of chemicals has come to overshadow, quantitatively, its other common uses, such as curing of meat and processing of other food products.

Production, utilization, and value of salt produced and used in the United States in 1945 are summarized in Fig. 1, which is based on statistics compiled by the U. S. Bureau of Mines. As the figures show, utilization of salt by the chemical industries was more than double that consumed in all other industries of the country combined. The figures also show that the value of salt produced and used as brine is considerably less than the value of either mined or evaporated salt.

The most economical way to produce brine is to drill a well into a deposit of solid salt, inject water into the well, and remove the brine thus formed through dissolution of the salt underground. This technique is used in making as much as 75 per cent of all the salt produced in the U. S. and 87 per cent of the total amount utilized by the country's chemical industries.

Two methods of water injection. Two methods of water injection are used to saturate a brine well. One is known as the "top water injection method"; and the other, where the operation is exactly reversed, is called the "bottom water injection method." Of the two, the first is the more conventional. Fig. 2 and Fig. 3 illustrate these methods.

Fig. 2 shows a diagram of a conventional salt well. The casing is set in an impervious stratum overlying the salt deposit, and an internal tube extends through this casing to the depth from which the brine is to be removed. Water is forced into the annulus between the casing and the tubing, and brine is removed from the tubing. The well is thus operated by the top water injection method. Where water is forced down the tubing to the bottom of the strata being dissolved, and the brine removed through the annulus, the well is said to be operated by the bottom water injection method. In either case, usual practice provides for water injection at sufficient pressure to force the brine to the wellhead without the use of well pumps.

Fig. 3 shows the subsurface conditions that might exist after a considerable period of operation of adjacent wells. After such a passage forms, it is customary to install tubing as large as can be passed through the casing, thus making the annulus useless; and to pump water into one well and take brine from the other.

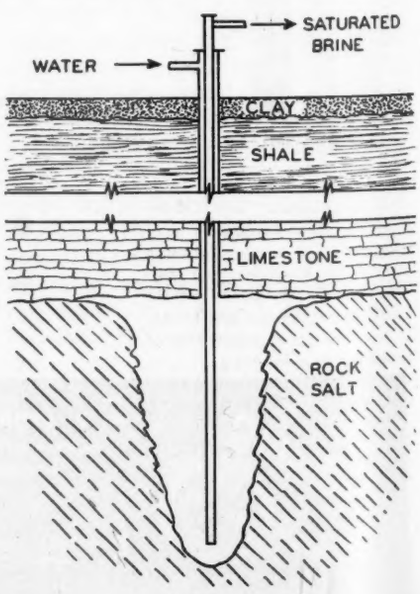
Sometimes the tubing is removed from the well used to supply the water. This does not constitute good practice from the operating standpoint, however, as it results in the equivalent of top injection operation. Note particularly that when repairs are required on either well, both are put out of service.

When a number of wells become interconnected by passages through the salt, it is not practical to lose production of the entire well group whenever any one of them undergoes repairs. Under such conditions, pressure of the water supplied to the cavity is generally reduced to a value insufficient to force the brine to the wellhead, thereby making it necessary to remove the brine with air lifts or pumps.

Requirements for minimum cost well operation. In a typical salt well operation, the cost of maintenance and depreciation on the wells themselves amounts to 70 per cent of the cost of brine production. Many years' experience in operating salt wells in a sedimentary salt deposit in northeastern Ohio, coupled with and corroborated by results of extensive tests with laboratory-scale model salt wells, indicate that well maintenance, which accounts for the lion's share of the cost involved in operating a salt well, is influenced a great deal by the shape of the cavity formed in dissolving the salt underground.

Experience shows clearly that:

FIG. 2. Typical brine well.



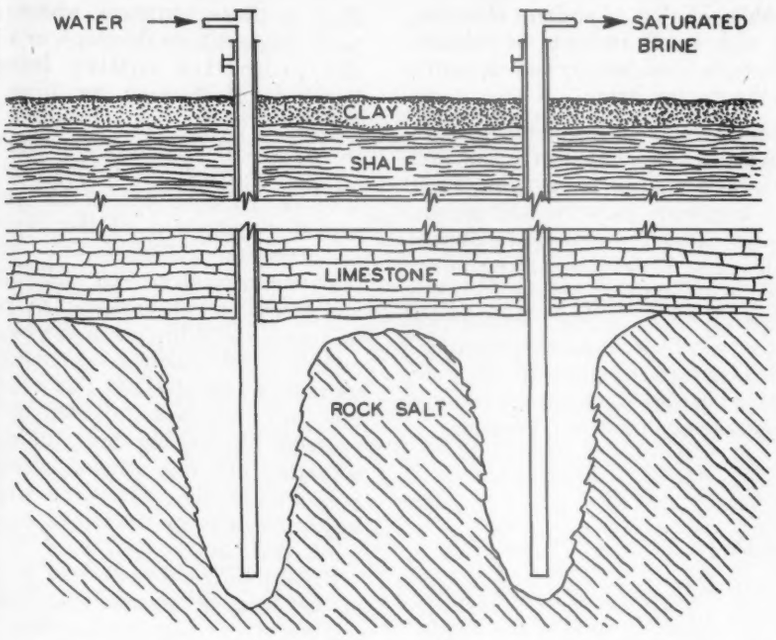


FIG. 3. Adjacent brine wells after formation of passageway between wells.

(1) The method of introducing fresh water into the salt stratum has a decided effect on the shape of the cavity formed.

(2) The selection of the most desirable method of salt well operation depends on three basic factors, namely: (a) thickness and depth of the salt bed; (b) character of strata overlying the salt deposit; and (c) degree of saturation required in the brine.

(3) The top injection method, most commonly used, produces the greatest capacity of saturated brine from a well in a comparatively shallow bed. It is likely to cause operating troubles, however, due to caving, accumulation of debris around the bottom of the tubing, and rapid spreading of the top portion of the cavity. Where top injection must be used, it is necessary to operate the well at partial saturation by the bottom injection technique for several months prior to placing the well in regular operation, so as to provide some width at the bottom of the cavity.

(4) The bottom injection method produces the most desirably shaped cavity, and is preferable in thick salt beds or where brine not exceeding 90 to 95 per cent saturation can be utilized. However, in thin salt beds where saturated brine is required, the salt capacity of a well operated by this method is too low to be economical in cost.

Because brine well maintenance represents such a large amount of brine production cost, it is quite obvious that keeping the cost of maintenance down to the lowest possible level is of great importance.

Even with a thick, hard rock strata overlying the salt bed, the amount of support that may be removed without causing caving of the cavity roof is limited. Caving of the roof is likely to damage the well tubing, a factor that becomes increasingly important in cases where the roof material is weak, such as shale and sandstone. In salt wells, as in any mining operation, the remaining roof support must be sufficient to prevent troublesome subsidence of the ground surface above.

In a properly designed well, there is little danger of damage to the well casing except for corrosion. Yet despite every practical precaution exercised, rocks occasionally fall and break tubing; drilling tools are lost in cleaning out the well; and there may be insolubles in the salt itself. So, after several years of operation, considerable debris may have collected in the bottom. Removal of such debris is costly. To circumvent this problem, it is much better to have a cavity at least 100 ft in diameter at the bottom, thereby making adequate provision beforehand for the accumulation of debris without jeopardizing or impeding well operation and maintenance.

The cavity most nearly approaching all the desirable features for dependable salt well operation at the lowest possible overall cost per production unit is a bottle-shaped cavity. A cavity of cylindrical shape ranks a close second. The bottom injection method tends to produce a cylindrical or bottle-shaped cavity.

Brine solution requirements rigid for electrolytic decomposition. Requirements covering the utilization of saturated sodium chloride solution in an electrochemical chlorine-caustic soda plant, are very rigid. For instance, no metals that form hydroxides that are insoluble in alkaline solutions can be tolerated. Also, organic material is especially undesirable; in fact, it must be removed completely from the electrolytic cell feed to insure safe cell operation. Furthermore, the solution used in this electrochemical process should be completely saturated.

Industry-wide production practice indicates that, as a general rule, the cost of treating the brine exceeds the cost of producing the salt itself. This is the case particularly when salt containing impurities is used as the raw material. It is obvious, therefore, that the quality of the source of salt assumes great importance.

Any area where oil field brines are available must be considered as possible salt sources. A typical analysis in parts per million of waste brine from oil field operations in the vicinity of Barbers Hill, Chambers County, Texas, is as follows:

Calcium Bicarbonate	234
Calcium Sulfate	21
Calcium Chloride	9,350
Magnesium Chloride	3,465
Sodium Chloride	80,800
Silica	11
Iron and Aluminum Oxides	11
Volatile and Organic Matter	(No data)
Total Solids	93,892

This brine contains only 7 per cent sodium chloride by weight, whereas saturated brine contains in excess of 25 per cent sodium chloride by weight. It would be necessary, therefore, to concentrate this brine by evaporation to make it usable, economically, in many chemical processes, particularly those producing liquid chlorine and caustic soda. Even after the brine is concentrated, further purification would be necessary that would be prohibitive in cost. Removal of the magnesium and organic matter present in such a brine would present a particularly difficult task. In fact, the most economical way to purify such a brine might be to remove almost all the water by evaporation, crystallize out the sodium chloride, then redissolve it.

On the other hand, the salt in the Barbers' Hill dome 17 miles from the new plant is exceptionally pure. Calcium sulphate is the only impurity

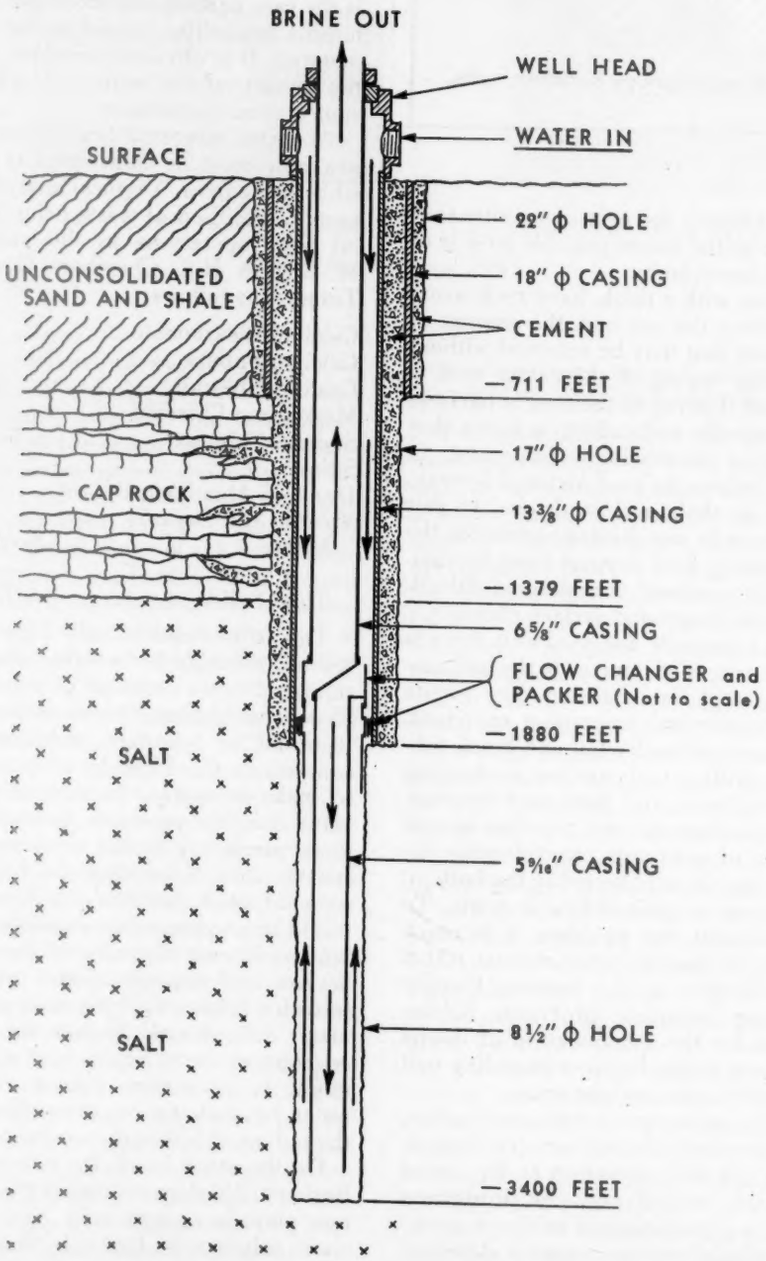
present in measurable amounts. It is not extremely soluble in the brine, and the calcium content can be removed easily by chemical treatment.

In addition, the shallow depth of the salt in this dome makes it possible to use the bottom water injection method of brine saturation. The wells are drilled deep enough into the salt so that the tubing can be pulled up or perforated, if necessary, due to deposits forming in the bottom of the well, without having to clean out the well itself.

Another significant advantage provided by the brine obtained from a salt well, as compared to natural oil field brine available near Houston, is that this solution of sodium chloride, even with small amounts of calcium sulphate, is considerably less corrosive than the natural brine.

▸ **Brine well casing and tubing protection.** Protection of brine well casing and tubing is a subject on which engineers have focused greatly increased attention and study during recent years. Among other things, they found, that corrosion of iron in brine is electrolytic in nature. Because of this characteristic, insulating coatings such as enamels, cement, etc., provide effective barriers to corrosion so long as there are no "pinholes" present.

FIG. 4. Diamond Alkali No. 1.



Investigation has disclosed further that in those instances where such pinholing exists or develops, or where the protective coating becomes knocked off through handling, the action of corrosion is localized and intensified. It is almost impossible to run coated casing and tubing in a well without removing some of the coating, and the protection of the threaded joints poses a problem.

Fortunately, however, well tubing and casing can be protected by bonding some metal higher in the electromotive series (such as zinc or magnesium) to the steel. At Barbers Hill, this protection was provided by galvanizing the casing and tubing, a measure that has proved effective, even though the galvanized coating was ruptured in spots while making up joints and running the pipe.

Brine piping above ground is made of cast iron, all joints being bonded electrically. Non-conducting materials, such as transite, are satisfactory for handling brine, presenting no electrolytic corrosion problems.

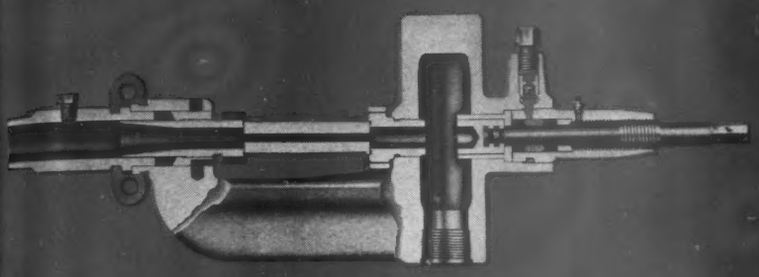
▸ **Two 500,000-gal brine wells supply requirements.** To supply the brine requirements of the new Houston Works, at Pasadena, two wells were drilled at Barbers Hill, each providing a capacity of 500,000 gal of brine per day, the total gallonage required for processing chlorine and caustic soda at the plant's designed output of 460 tons daily. These wells are spaced about 850 ft apart, a provision that should permit them to be operated for many years before the formation of a passage through the salt between the wells.

The section through No. 1 well (Fig. 4) shows the depth, sizes of hole, casing program, and formations penetrated. No. 2 is similar. In most salt domes, the cap rock is porous; hence, about 500 ft of salt is left above the casing.

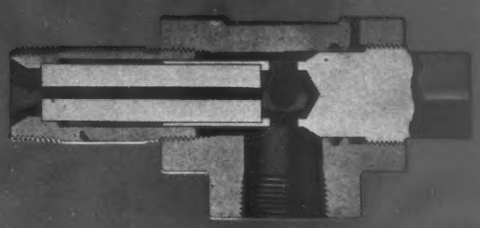
▸ **Installation of flow changer planned.** These wells at Barbers Hill are designed for the installation of a flow changer, that will permit admittance of fresh water to the annular space between the casing and the tubing. The flow changer will transfer the fresh water stream from this space to the tubing at a point near the casing shoe. Brine from the top of the cavity will pass through the flow changer into the tubing, thence to the wellhead. By means of this device, brine should be prevented from contacting the casing, thus confining corrosion to the tubing, which can be renewed.

Although bottom injection operation has proved practical with salt beds 500 ft or less in depth, it has been found that a deeper working face increases well capacity. The wells at

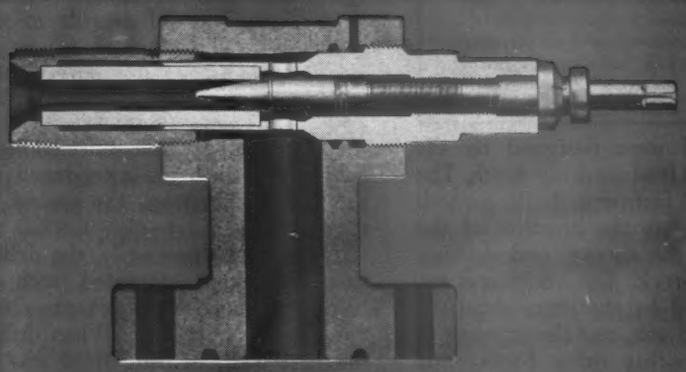
To Better Equip Any Tree...



Cameron Type "D" Flow Wing



Cameron Type "G" Positive Choke



Cameron Type "G" Adjustable Choke

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Cameron Flow Wings are unique in that they not only provide all the fittings required for a complete Christmas tree wing in a single, compact unit, but greatly simplify the choke changing operation. Note that the flow bean, or choke, is not enclosed, making it instantly accessible. Two turns on a clamp screw releases the bean. There are no threaded connections to break out or flanges to remove for this operation. It's fast and simple. A built-in, easy-to-operate valve provides a shutoff while changing chokes. No need to close any vital valves on the Christmas tree.

The new Cameron Type "G" Chokes feature a positive and adjustable choke assembly interchangeable in one choke body. *No bean wrenches are required to change* beans. Note that the bean retainer provides a tight friction grip around the bean so that when the retainer is backed out of the body the bean is retrieved with it. As a safety feature, pressure trapped in the body is automatically relieved through a port before the retainer is removed.

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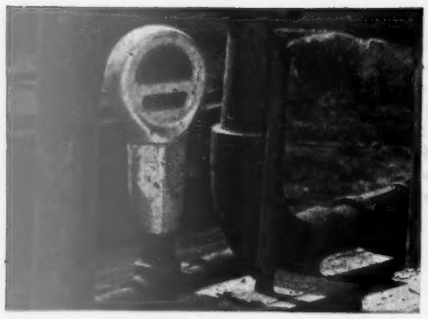
Sturdily constructed, and with the external parts working in oil, these fine Cameron Gauges are providing long trouble-free operation under the severe field conditions for which they were designed.



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Arrangement of wellhead.

Barbers Hill were designed on the basis of 1000 ft of working depth. The principal cost factors in drilling a well such as this are the erection of the drilling rig, the casing, and drilling through cap rock. The additional expense entailed by the extra depth of drilling in the salt, and the expense of the corresponding extra footage of tubing required is not excessive. Accordingly, an initial working face of 1500 ft was provided in each well to allow for raising the tubing, as anhydrite accumulates through years of operation, without decreasing well capacity.

First few months form most critical period of well life. The most critical period in the life of a salt well are those first few months of operation when the cavity formed is small and there is little room in the bottom of it for anhydrite accumulation. When placing a new well into service, it is important to operate the well continuously for at least a period of one year. Moreover, to facilitate raising the tubing during the initial operating period, flow changers should not be installed. As indicated earlier, it is planned to equip the wells with these units at some future date. Presently, the water supply is connected to the tubing, and the brine is produced from the annulus between the casing and the tubing.

In drilling these wells, the drilling fluid was kept saturated with salt below the caprock to prevent enlargement of the bore hole. When drilling the first well, drilling fluid was saturated with purchased rock salt. Saturated brine from No. 1 well was employed, however, to make up the drilling fluid used in No. 2.

From the very first hour of operation, these wells produced full capacity at close to saturation. This accomplishment may be attributed directly to the deep working face provided. With wells having a working face of from 100 to 500 ft, it is usually necessary to "waste" the brine during the first few months of operation until a cavity of sufficient size has been formed to provide the retention time required for saturation.

At all capacities, these wells have produced clear brine with the anhydrite being left in the well. As a result, the problem of settling and disposing of the anhydrite, which is usually brought to the surface by top injection operation, has been effectively eliminated. * * *

Back-Off Method to Recover Stuck Pipe

J. M. KLINE

DEVELOPED in 1945 and now used extensively throughout the oil industry, the "back-off" method of recovering stuck pipe has become a valuable aid in fishing. Although relatively new, compared with other well-known methods in use for freeing pipe, this method has been used on more than 1000 fishing jobs. About 300 of these jobs have been in the mid-continent fields since the service became available in this area in 1948.

Major use for the back-off method has been for unscrewing drill pipe. It has also been used many times for unscrewing drill collars and tubing and, in a few cases, for unscrewing washover pipe.

Principle of Method. The back-off method uses an explosive jar to begin the unscrewing of a particular tool joint or threaded coupling. The explosive jar or impact is designed so that the pipe will not be stressed beyond its elastic limit. Backing-off at the desired depth is accomplished by neutralizing the weight of the pipe at the point to be unscrewed; applying a torque at the surface that tends to unscrew the joint; lowering the back-off shot to the desired depth; and detonating the explosive charge to loosen the threaded connection.

Type of Shot Used. Two general types of shots have been used namely, the "string shot" and the "bomb shot." In the bomb shot, the explosive charge, consisting of a high temperature material such as tetral, is contained in a short steel or aluminum alloy tube that is placed in the desired joint by collar finder wires. The bomb shot may be attached easily to the bottom of the carrying weights and concentrates the explosive jar within the joint to be unscrewed.

The string shot has been the most popular type. It is made up of a variable number of strings of Primacord detonating fuse. The individual strings are ¼-in. in diam with an explosive core of either 50 or 100 grains per ft of pentaerythritetetranitrate (PETN) contained within a water-proofed covering. This material is well adapted for well work since there is relatively no danger in the handling or storage of it. It cannot be set off by friction, sparks, or any ordinary shock but must be detonated; and this requires the use of an electric cap attached to it. An indication of the harmless character of Primacord is that it is accepted without restriction by transportation and express companies.

The intensity of the string shot may be readily varied on the job by changing the number of strings of Primacord. This is essential since the intensity of the impact required to begin the unscrewing of a joint is dependent upon the type of joint to be unscrewed and the back-off depth. For example, to back-off 4½-in. drill pipe at 4000 ft in normal clay, unweighted mud would require four 50-grain per ft strings, whereas, 7-in. drill collars would require seven strings. Additional strings would need to be added with increase in depth or weight of fluid.

The string shot may be run in various lengths, but it is commonly run in lengths three ft longer than the joint of pipe. Thus, if the joint to be backed-off is 30 ft in length, a shot 33 ft long is run. This assures that the shot will lap at least one tool joint and the problem of locating a joint is eliminated.

Detonation of the Primacord is practically instantaneous over the full length of the shot as the explosive wave travels about 20,350 ft per sec. This produces a vibratory effect in both joints of pipe and makes it possible to use a smaller explosive charge per ft, thus minimizing the danger of damaging the pipe.

Back-Off Operation. The actual back-off operation is very simple. After determination of the free point, the pipe is lifted so that the joint to be backed-off is neither in tension nor compression. Back or reverse torque is then placed and held in the pipe, either with the rotary table or with tongs, so that the pipe will tend to unscrew with the detonation of the shot.

A regular electric conductor cable, the same type as used for gun perforating or electric logging, is used for running the shots to the desired depth in the well. The bomb type shot is carried on the bottom of a suitable weight. The string type shot is attached to a steel by-pass line with weights below. This arrangement keeps the shot "strung out" while being run and the by-pass line carries the weights back to the surface.

With detonation of the shot, the joint often completely unscrews. In many cases, however, it is necessary to apply additional back torque and work the pipe since the weight may not have been sufficiently neutral at the joint or the pipe not completely free.

Costs Reduced. With use of the back-off method it has been possible to reduce materially the cost of recovering stuck pipe. One major saving is in rig time, because the time required for running the shot on an electric conductor cable is very short compared with conventional cutting and fishing methods. Another saving results from reduced equipment, rental, and transportation costs, because no additional equipment such as cutting pipe is required. Also, the normal pipe replacement cost due to cutting is minimized, because it is usually

The Author

J. M. Kline, engineer with the Dia-Log Company, has been connected with the oil industry since 1929. Following six years of field experience in drilling and production, he decided to equip himself to do a better job, and enrolled at University of California, from which he emerged in 1939 with a BS degree in petroleum engineering. For eight years after graduation he was a member of Richfield Oil Corporation's engineering staff, during the last two years acting as chief production engineer. He joined Dia-Log Company and the Ford Alexander Corporation in November 1947.

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possible to back-off without damage to the pipe.

The actual cost of unscrewing a stuck string of pipe is often surprisingly small. For example, the time required for rigging up and running the shot will probably not average more than four hours. The cost of the shot itself increases with depth but it is nominal, averaging less than $300 per shot plus usual service charges for mileage, etc.

Drill Collars Recovered. Backing off of drill collars has now become a normal procedure. This is a valuable feature, especially in areas where a large number of drill collars are run, because, in the case of drill collars, cutters cannot be used and it is often not possible to wash over their full length. By washing over and backing off in stages, many bad fishing jobs have been cleaned up. Subsequent back-offs can be accomplished either by taking hold of the collars with a socket or by screwing into the top of the fish.

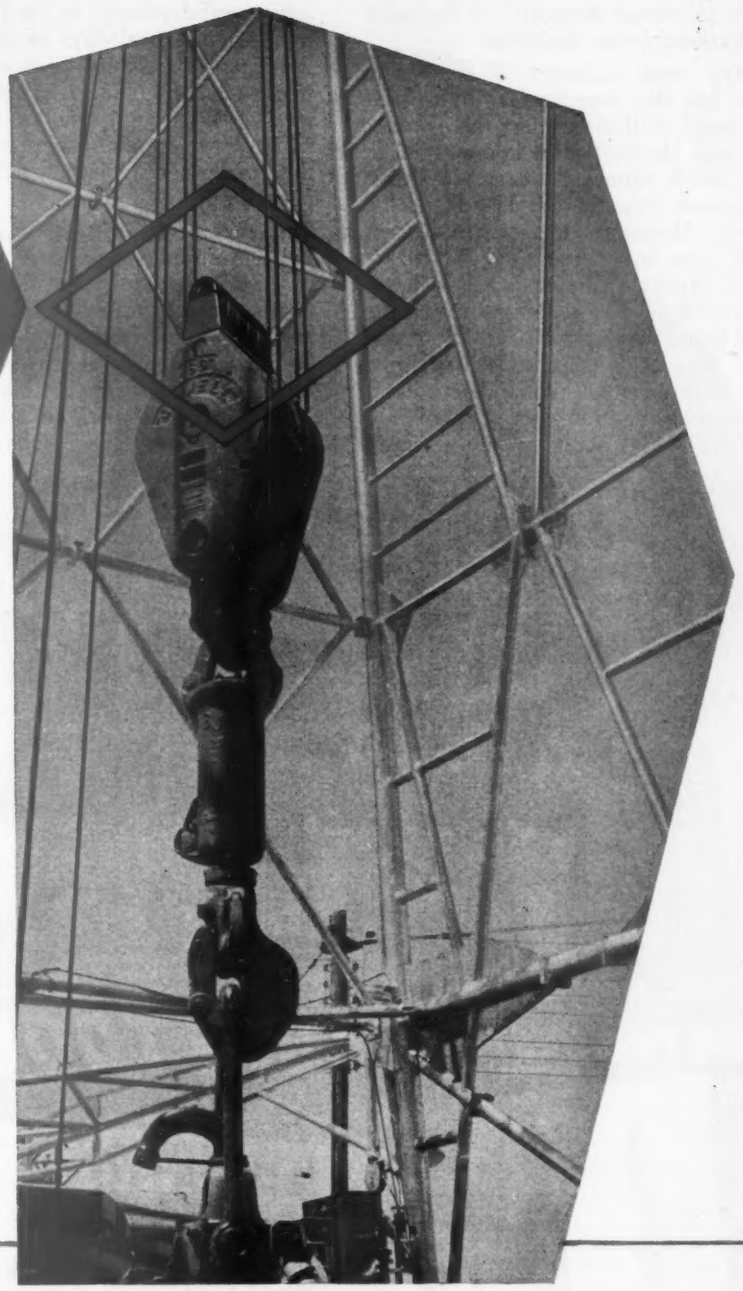
Running Through Fishing Tools. An important feature of the string type back-off shot is that its diameter may be kept as small as ¾-in. This permits it to be run through openings in overshots, jars, bumper subs, taps, etc. This is especially valuable in cases where the fish has been engaged by fishing tools and either it is not pos-

FIG. 1. Left. Preparing a "string shot," which will supply the explosive impact necessary in the back-off method.

FIG. 2. Lower left. On the walk of a West Texas well the string shot may be seen extended, being about 3 ft longer than the joint of pipe to be backed-off.

FIG. 3. Below. The strings of detonating fuse are attached to steel by-pass line and weight.

Rigged for Safety



Before the rotary hose was even connected to the swivel, this crown block was rigged for safety. This operator bought a Patterson-Ballagh Block Bumper for his new equipment before the well was spudded in. He knew that an accidental block crash into the crown could cost him the well and ruin costly equipment, not to mention possible injury to the crew.

If you've ever seen the wreckage after the traveling block has smashed against the crown, it is obvious that much of it could have been prevented if shock-absorbing Patterson-Ballagh Rubber had been there to cushion the crushing impact. Even if the block only nudges the crown, sheaves are bent and wire lines injured. The cost to repair even such a slight bump would more than pay for a Patterson-Ballagh Traveling Block Bumper. Order one today!!

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sible to release them or it is desirable to back-off below the tools.

The small diameter of the string shot has also been useful for backing off small drill pipe where the opening through the tool joint is too small to run inside cutters. An example of this occurred recently on a well in the Rocky Mountain area where 2⅞-in. drill pipe was being used for repair work through 5-in. casing at a depth of 10,900 ft. The opening through the tool joints was only 1¼-in. The string shot was used to back the drill pipe out of the one drill collar being used. A safety joint was then screwed into the drill collar, with jars above, in an unsuccessful attempt to jar the collar out. After several days of jarring, it was found the safety joint would not unscrew. Although the diameter of the wash pipe through the jars was only ¾-in., a string shot was run through this small opening and the safety joint backed off.

Recovery of Tubing. Tubing threads have been found to unscrew as readily as a drill pipe tool joint, thus leaving an undamaged joint up for future fishing operations. In the case of tubing, however, it is often necessary to make up the string first so that back torque may be applied without some joint breaking. More than 25 strings of 2- and 2½-in. tubing have been backed off. One string of 2½-in. tubing in the San Joaquin Valley was recovered from 11,450 ft after being cemented in hole during plugback operations. Several strings of tubing have been recovered from above stuck packers.

Back-off at 14,211 Ft. Back-offs have been made from just below the kelly to below 14,000 ft. On the deepest back-off to date, a string shot was used to unscrew 3½-in. drill pipe one joint above the drill collars at 14,211 ft on a barge location in Lake Pelto, Louisiana. Back-off shots have been effectively detonated as deep as 16,802 ft. The pipe was not backed off at this extreme depth, however, due to being stuck higher up the hole.

Effective back-offs have been made in directional holes with angles of as much as 60 deg. Several jobs of this type have been performed in the Wilmington and Seal Beach, California, fields with no unusual problems due to the hole being off vertical. On holes with angles of more than 40 deg, however, it is usually necessary to pump the shot down.

Limitation of Back-off Method. As with other oil tools, there are several limitations in the application of the back-off method. One is that it is not always possible to run to the desired depth due to restrictions such as heavy mud where there is no circulation. This is especially true where a fish has been screwed back into, or taken hold of, with a socket, because wall cake may have entered the top of the fish. Another limitation is that it can be used only on those wells where it is possible to put reverse torque in the string of pipe.

Although the back-off shot is designed so that the pipe will not be stressed beyond its elastic limit, a joint is split occasionally. This may be due to several reasons. First, certain joints require a heavy jar to begin unscrewing and, if it is believed that the joint is above the stuck point but still it does not unscrew, there is a natural tendency on the part of the operator to increase the strength of a second shot which may cause damage. Also it has been found that damage is more apt to occur when repeated shots are made in the same joint. Too, there is always the unknown quantity—the condition of the joint; if the joint is fatigued, it is, of course, more susceptible to damage. Even though a joint is split, however, the damage is usually such that it does not hinder further fishing operations.

The back-off method has now been used in every oil producing state west of the Mississippi, in Canada, and in South America. ***

FOR THE BEST IN CABLE TOOLS

Fig. F460 Fig. F467

SPANG
CENTER ROPE SPEAR
(Fig. F460)
THREE-PRONG GRAB
(Fig. F467)

For fishing broken cable and sand line, Spang furnishes a variety of Center and Side Rope Spears, as well as Two- and Three-Prong Grabs.

Strands of cable left attached to the rope socket may be removed with the Spang Drill Mill, or the Spang Drive Down Socket or Trimmer.

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Magcobar FIBER-SEAL—a new and improved fibrous mixture containing strong, hair-like fibers that build an impervious mat in fissures, cracks and porous formations through which mud will not pass—it is a major contribution toward the ultimate solution of the hazardous and costly problem of *lost circulation*.

In developing FIBER-SEAL, the first consideration was to find a material that would form an impervious bridge in large openings and yet not foul the valves and other working parts of the circulating pumps. Exhaustive field tests indicate that FIBER-SEAL is by far the most desirable material developed to date for this purpose.

FIBER-SEAL is loosely packed in paper bags of convenient size for easy handling. It may be added through the hopper or directly to the mud pit. No hand fluffing is necessary. A few sacks will often stop mud loss promptly.

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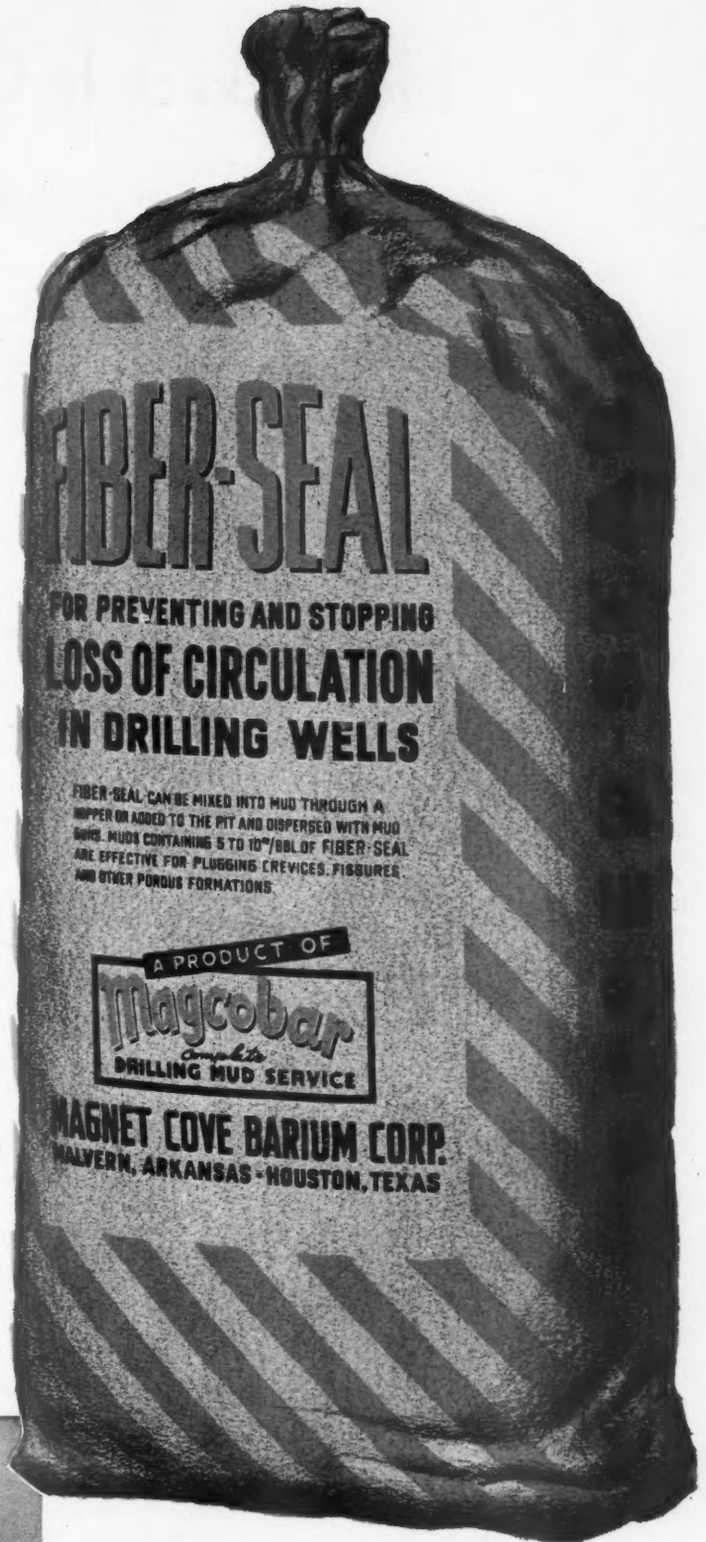
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How Exact Is Gas Metering?

By FLOYD K. BEACH*

So long as gas is measured only once the operation is a simple one. A displacement meter may be inserted in the pipe for the gas to pass through. Then

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readings of the hands or numerals at stated intervals permit the accounting staff to deal with quantities involved. Or an orifice may be inserted in a meter run of pipe. Taps upstream and downstream from the orifice plate are led to a meter, which records continuously the pressure and differential. The charts are computed and again there are quantities that can be dealt with by the accounting staff. But just start making check measurements intended to detect leaks, to detect losses due to removal of natural gasoline or impurities, or merely to verify transactions, and one runs into difficulties. If successive measurements made along the stream of flow are consistently smaller, and if they are verified by expected results of intermediate operations, all is well; but when the flow as it leaves a gas field is measured and the same flow is again measured as it enters a city some miles distant and an apparent increase in quantity appears, one begins to question the exactness of the measurement operations. Or when a vendor measures the flow from each well of a group and the purchaser measures the combined flow entering his main and the two sets of figures fail to agree by 10 to 25 per cent, some diligent work may be needed to run down the cause of discrepancy and determine which set of measurements is nearer the truth.

We do not intend to go into the basic principles of gas metering here, but rather we record some of the snags that have come to our attention, snags that were eventually shown to have caused poor metering.

Some of these snags could not have been met in metering gas that is produced from a field that has no oil; others are applicable to any gas metering, but we shall not attempt to touch on all the troubles that might be involved when there is failure to observe specifications.

Although we shall not discuss displacement meters at length, it is only fair to remark that we have seen gas metered through a displacement meter at some pounds above atmospheric pressure and the readings accepted without correction. Under such conditions the readings would not be valid proof of error in an orifice meter measurement of the same stream. Most displacement meter installations are on consumers' services where line pressure is regulated at a few ounces above atmospheric pressure. If a usual 6 oz pressure drops to 3 oz the consumer may get only part of the gas supply he wants, but the measurement will not be seriously affected. The 3 oz lower pressure than normal is still a smaller factor than variations in the barometer and it has a smaller effect than the cooling of incoming gas in cold weather. It would not be economically feasible to correct displacement meter readings for every change in barometric pressure nor for every change in flowing temperature, yet these factors materially affect the measurement of a given mass of gas and make it difficult to reconcile the sum of individual deliveries with orifice measurements. Our further comments relate to the comparisons of orifice metering.

● **Assumptions.** In orifice metering it is assumed that installation of meters has conformed in general to the specifications of the American Gas Association.[1] It is expected that variations in inside diameter of pipe may enter when pipe of various weights has been available, and that installations have been made by pipe fitters who are not necessarily expert in gas measurement, with some consequent latitude in interpretation and in execution of the fittings.

It is assumed that specific gravity of the gas is determined only occasionally, but that temperature near the orifice is measured fairly frequently and proper corrections made, and that in general the calculation of coefficient and chart reading with extensions conform with the provisions of the AGA report mentioned above.

It is also assumed that even the smallest gas leak is not permitted in the leads or meter, and that the meter has a level setting.

● **Supercompressibility.** The AGA[1] report refers under the heading of supercompressibility to the need of its application but states, "before any supercompressibility factor can be applied to the measurement of a particular gas *an actual determination of the deviation from the ideal gas law, over the range of the flowing pressures and temperatures involved must have been made.*"

Since the date of that report, research indicates that specific gravity is a sufficient criterion to use in connection with temperature and pressure of gas that is essentially composed of paraffin hydrocarbons. The writer has shown[2] that even considerable dilution of paraffin hydrocarbons by hydrogen sulphide should not seriously affect the metering accuracy so long as specific gravity is measured. The tables A-2 to A-7 published[3] by the California Natural Gasoline Association, provide data for this factor, applicable for a range of specific gravities from 0.55 to 1.50, for pressures from atmospheric to 500 psia, and for temperatures from 40 to 150F. Use of these values has been standard practice in Alberta for some years and has permitted elimination of some of the discrepancies in gas metering. Our experience has not often run into problems of high pressure metering above 500 psi, but a paper by Matthews, Roland and Katz[4] contains valuable data on such problems.

● **Metering comparisons.** In Turner Valley three natural gasoline plants collect gas from some 210 wells (or groups of wells metered as one). During the year 1947 nearly 28 billion cu ft was gathered and after accounting for disposals, unavoidable losses, shrinkage on extraction of natural gasoline and impurities, there remained more than half a billion cubic feet unaccounted for. On using exact figures the combined percentage of error and of unknown transmission loss was 1.9 per cent. It is probable that in reading the average meter chart, two persons might differ by about this amount. On a chart having a few fluctuations they might read more closely, but on charts having large and frequent fluctuations of flow, the individual differences might be considerably greater. Thus on the average the comparisons are reasonably good, and we would have little complaint. The real difficulties arise when smaller parts of the whole picture are examined.

One plant has shown consistently more gas entering it than the sum of deliveries from wells to the gathering line. Considerable attention has been given to this system and some of the causes for this condition have been found.

At most points where another plant accepts delivery of gas, the flow is measured both by vendor and purchaser, and discrepancies as great as 10 to 25 per cent have been noted.

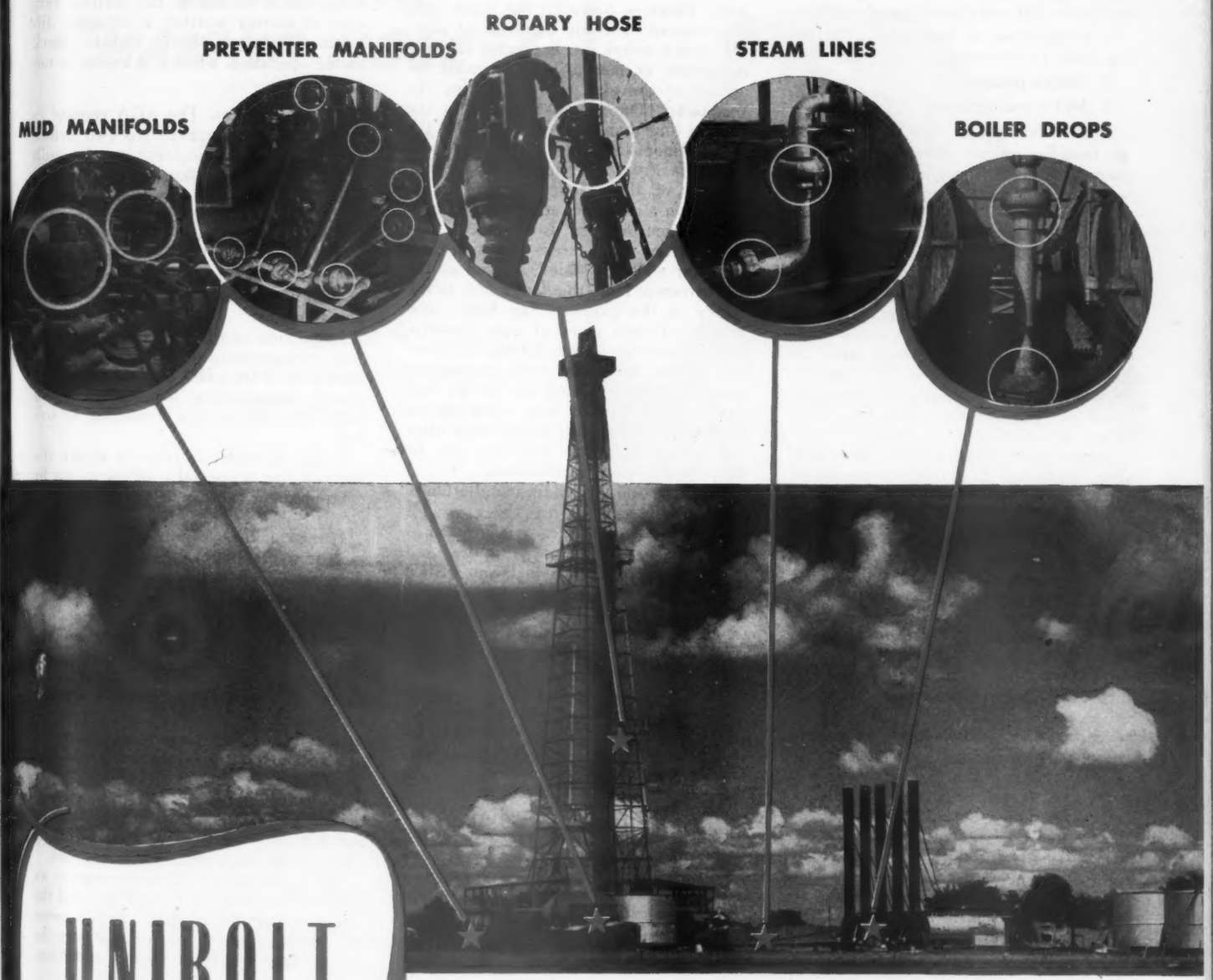
One cannot arbitrarily say that either of the measurements is wrong, but must look into the cause. The Petroleum and Natural Gas Conservation Board has acted as an impartial referee in many of these discrepant records. The Board's engineer in charge in Turner Valley is R. H. King, while L. Hicklin has done most of the meter inspection under his general direction.

Inspection reports from the field suggested that conditions had been found to cause poor metering, a record of which might be of interest to others, and in preparing this article the writer has re-

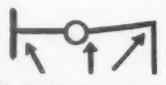
*Engineer, Petroleum and Natural Gas Conservation Board, Calgary, Alberta.

STRESS-FREE LINES LEAD TO

Economical Rig Maintenance

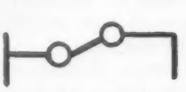


UNIBOLT *Flexi-Ball* JOINTS



STRESS HERE

Using only one Ball Joint does not properly eliminate stress resulting from contraction or expansion.



NO STRESS

Using two Ball Joints in series eliminates stress resulting from contraction or expansion.

The Flexi-Ball Joint, which provides for misalignment up to 38 degrees, depending on the size of the joint, is designed to relieve lines of stress resulting from expansion, vibration, or misalignment. It is a "natural" for flexible manifolds.

The proven UNIBOLT coupling principle is employed to join the component parts of this fitting. As a result, trouble due to galling and freezing of threads is entirely eliminated by the Flexi-Ball design. It is assembled by the simple process of tightening one bolt with an end wrench. Even after extended periods of service, the joint can be quickly dismantled by releasing the bolt.

This fitting may be used safely in any service, since it is made in steel only. Its sizes range from 1½" to 6" and test pressures to 6000 lbs., depending on size; 500 lbs. steam working pressure.

THORNHILL-CRAVER COMPANY

HOUSTON, TEXAS

ceived cooperation from T. Mason Macdonald, representative of Peacock Brothers, agents for The Foxboro Company.

● **Source of error.** Remember that most of these comments arise from Turner Valley experience. There most of the gas has first to be separated from oil, and there is always the chance of oil being carried over into gas lines from the separator.

An analysis of the causes for metering error suggest that they may be arranged under the following headings:

1. Installation of meter runs, including leads to the meter.
2. Orifice plates.
3. Meter maintenance.
4. Maintenance of meter runs.

● **Installation of meter runs.** When there is sufficient vertical space from separator outlet to ground level, vertical runs provide opportunity for any oil carried over from the separator to drain out. This avoids errors due to liquid accumulation behind the orifice plate.

Straightening vanes are avoided in Turner Valley. Some wax may be carried over from the separator and it tends to collect on pipes and would build up badly on vanes, so that if AGA specifications call for straightening vanes because of short distance from an ell or valve, horizontal runs are used.

Some of the discrepancies have possibly been due to liquid accumulation behind the orifice plate in horizontal runs.

Sec. 34 of the AGA specifications[1] calls for no recess exceeding ¼ in. between the end of the pipe and the upstream face of the orifice plate. If a greater distance is left, the recess is to be "filled with poured lead or other material that will not be attacked by fluid in the pipe, so as to make the inner surface of the pipe smooth and continuous up to the orifice plate." Failure to observe this specification has been a most frequent source of error and correction of this fault has often been sufficient to correct discrepancies between meters. Once the meter run has been set up this reason is a difficult mattter to detect and calls for taking down the run for inspection—an expensive operation in comparison with the cost of doing the job properly at the start.

At times when tapped flanges were not available for meter run installation, blank flanges have been drilled in a field shop and tapped for meter connections. Some of these holes were allowed to wander with the result that the distance from the orifice plate is less than the full inch specified in Sec. (F)[1] and this departure from specifications is blamed for some metering discrepancies. Data given by Spink[5] suggest that when taps are too close to the plate the error increases rapidly, whereas with increasing distance from the plate there is less adverse effect. The error is presumably due to eddies set up at the plate.

In some of these installations using unconventional flanges, orifice plates intended for conventional flanges have had to be scored around the edge to permit insertion of flange bolts. Irregular scoring puts the orifice off center with unfavorable effect on metering accuracy.

It is inevitable in a field where odd lengths of various kinds of pipe are available, that meter runs are likely to be made up of pipe that is not of the nominal inside diameter provided for in tables. There is an adequate amount of data available to permit calculation of orifice coefficients for unusual pipe and orifice diameters, so no great objection can be brought against use of odd sized pipe. There is, however, the great need of a record of inside diameter of pipe, for once a meter run is erected there is no means of measuring the inside diameter of the pipe short of taking the run apart. One company calipers the pipe in four diameters 45 deg apart, the measurements being taken about an inch upstream from the orifice plate. The average of these four readings is recorded on a diagram, and similar downstream measurement is recorded. Distances from the nearest ells and thermometer well are added, as well as the measurement from the flange face to the center of the pressure tap holes, and lengths of each piece of pipe, description of valves and other fittings. A drawing of the assembly with dimensions marked is then placed on file so that anyone in the office may check up on dimensions not readily measurable after the run is in place, and this can be checked for each installation.

The quick-change plate installation is increasingly used. It has the great advantage of permitting easy inspection of the orifice plate currently in use, and of quick substitution of a larger orifice for a period of large flow or of a smaller orifice for a period of small flow. It has the disadvantage that substitution of a new size of plate could be made without the chart reader's knowledge if there is carelessness in noting the change on the chart, but this disadvantage is not so great as with the slow change installation where carelessness might go longer without detection.

Any accumulation of liquid in the pipes leading from pressure taps to the meter, or accumulation in the meter itself, may introduce false differential readings. If the liquid is water, it may freeze in cold weather and cause troubles ranging from false readings to total failure of true differential or even static pressure to reach the meter. The installation of drip pots at low points on both leads to the meter helps. They should be provided with petcocks for drainage, and where liquid condensation is frequently found their drainage should be part of meter operation. Provision of drip pots also makes certain that any mercury blown from the meter will be caught—an important precaution when mercury is scarce and costly. The meter manufacturers provide automatic stops to prevent loss of mercury, but occasional presence of wax might prevent functioning of the stop.

Some metering errors doubtless have been due to accumulation of liquid in the lead pipes, and some have been due to condensation of light fractions within the meter. This has been noticeable when the meter is not housed in a warm building. Condensate builds up when the meter is cold and a chart is usually put on about 8 a.m. when accumulation is at a maximum, and the operator may at that time zero the meter. As the temperature rises during the day, the condensate evaporates and disappears in the gas flow. Thus maintenance of a fairly uniform temperature of the meter itself would be an advantage. Most meter cases are weatherproof when the front cover is closed, but during very cold or stormy weather it becomes difficult to change charts and to check meter operation when the meter is not housed.

● **Orifice plates.** The AGA report[1] in Appendix C remarks: "No two orifice meters except by accident can be built to give exactly the same readings when the same amount of gas is flowing."

This leads to the observation that there are individual characteristics for each orifice plate. It is most desirable to identify each plate by a serial number as well as by a stamped marking of orifice diameter.

Inspection of plates involves micrometer measurement of orifice diameter, thickness of the plate at the orifice, and visual examination for sharpness of edge, for dishing and centering of orifice.

If the diameter is over or under the marked size, a special coefficient can be computed for the exact measured diameter.

If the thickness exceeds the AGA specification the plate should be rejected. A recent discrepancy of about 10 per cent between meters on the same stream was traced to a trick plate that had been beveled instead of being counterbored.

It is common practice to hang spare plates on a nail driven into the wall. A little carelessness results in blunting the orifice edge, then most erratic results are obtained after it has been put into use again.

Slugs of liquid or of ice sometimes dish a plate, and after such an occurrence it must be rejected if the dishing exceeds the AGA permissible amount.

Slow change installations require an ear that projects far enough beyond the flange to permit reading the diameter and serial number and to make sure the proper face has been turned upstream.

● **Meter maintenance.** If a meter fails to record the pressure and differential readings definitely, accurately, and continuously, poor results may be expected. If the pressure is accurately regulated to a fixed figure, this statement could be modified, but in general the principle is true. It doesn't matter very much what cause is responsible for failure to obtain true and continuous readings.

One of the most frequent troubles is in the pens, which may fail to write or which may feed too much ink. Operators have a habit of bending pen arms. They see the two pens at different angles and think one of them should sit at the same angle as the other, and bend the arm with the result that the record is not in

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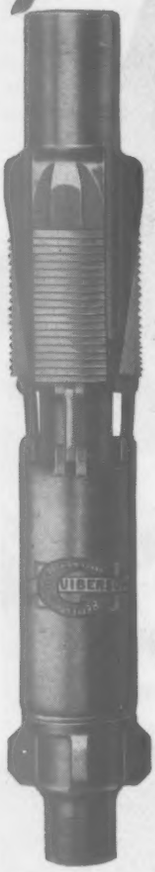

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the proper place on the chart, or the pen may not work at all until repairs are made.

The pressure element seems to be subject to attack by sulphur in sour gas and may eventually fail to respond to pressure changes, when a new element will be required. Many meters when installed require a pressure element with 500 psi range, but as the field is depleted ordinary operating pressures have fallen until there is not sufficient sensitiveness to pressure change in the present range of pressures. This also calls for replacing the pressure element.

In recording differential, the float must be free to rise and fall with changes in differential and its movements must be freely transmitted to the pen. A difficulty encountered in Turner Valley that may be unusual elsewhere is accumulation of wax on the float chamber walls, and this has sometimes been in quantities sufficient to damp or even stop movement of the float. Its presence is hard to explain other than by accidental slugs of crude oil coming over from the separator and on striking the orifice plate being forced over into the meter.

Accumulation of wax or other material on the walls of the range tube would give very bad results, but Turner Valley experience suggests that more trouble is to be expected in the float chamber, which is connected to the upstream side of the orifice, and which therefore is more susceptible to flooding by oil. The whole scheme of calibration is based on relative sizes of float chamber and range tube, and any change in diameter of either is cause for poor performance even if the wax accumulation is not great enough to damp the float movement.

The movement of the float is transmitted to the pen arm through a pressure tight bearing and it tends to seize at times, when repair or renewal becomes necessary. There is provision made for putting in grease under pressure and if too much grease is put in, stresses are set up that may call for servicing.

Loss of mercury may result in cutting down the maximum reading of the differential pen. It may then indicate a steady differential somewhat below the maximum when actually the reading should be higher.

The chart is turned by a clock that, like your watch, needs cleaning and oiling at least once a year, and may need more extensive repair occasionally. Operators sometimes think if they dip the clock in gasoline and oil it themselves that they are helping out, but it is good practice to send every meter for a full overhaul about once a year.

The metering of pulsating flow is always a problem. Some wells pulsate because of the manner of oil movement from the bottom of the well. Occasionally such a well paints a broad band of color that presents a problem requiring much ingenuity in interpretation. Sometimes the problem can be solved by an hour's test run using a clock that turns the chart through a whole revolution in an hour. The result may be sufficiently detailed to allow calculating the position of a reading giving a mean value between the limits of the band usually painted solid.

● **Maintenance of meter runs.** Recently a metering difference arose between vendor and purchaser. The purchaser was recording only about three-fourths of the amount indicated by the sum of the vendor's meters. Each of five wells operated by the vendor had a meter, while the purchaser measured the combined flow in a single meter. Tests of each of the vendor's meters were run against the purchaser's meter. The fact that in each test the difference was in the same direction and about the same percentage, led to suspicion of the purchaser's meter. When all ordinary tests failed to disclose the cause, the purchaser's meter run was taken down. It was found that wax had collected both upstream and downstream from the orifice plate until the effective pipe diameter was only slightly greater than the orifice. Removal of the wax and re-erection of the meter run brought the two sets of measurements into virtual agreement.

Although this occurrence could not happen in a field containing no oil, it does point to the adverse effect on measurement that may be expected if scale should collect in the meter run, or if liquid of any kind collects above the orifice plate. It is good practice to provide drip cocks in horizontal meter runs and to blow them down as often as is necessary to take care of condensate. Most natural gas fields have enough connate water in the sand to saturate the gas with water vapor and some of this is likely to condense in the meter run.

● **Summary.** Given a problem of gas metering to be carried out by a single organization, the engineer can lay a good foundation by careful installation of meter runs that adhere strictly to AGA specifications, combined with a complete office record of each installation with measurements of all hidden dimensions as well as of those that are accessible.

In order to achieve measurement results that permit reconciliation and that truly indicate where losses occur, even in a system under control of a single organization, a comprehensive system of operation and maintenance is necessary, and all indicated corrections to orifice meter coefficients must be made for variations in temperature and pressure.

In trying to reconcile measurements made by a number of organizations one must expect greater difficulties than in a system under a single control.

● **Bibliography.**

1. *Gas Measurement Committee Report No. 2*, booklet published May 6, 1935, American Gas Association, 420 Lexington Avenue, New York, N. Y.
2. "Effect of Hydrogen Sulphide on Coefficient for Orifice Gas Meters," F. K. Beach, *The Petroleum Engineer*, March, 1946.
3. "Tentative Standards for the Determination of Supercompressibility Factors in High Pressure Gas Measurement," *Bulletin TS-354*, published in 1935 by California Natural Gasoline Association, Los Angeles.
4. "High Pressure Gas Measurement," Matthew, Roland and Katz, *Refiner and Natural Gasoline Manufacturer*, June, 1942.
5. "Characteristics of Differential Flow Meters and Factors Affecting Their Operation," L. K. Spink, *The Petroleum Engineer*, October-December, 1944.

★ ★ ★

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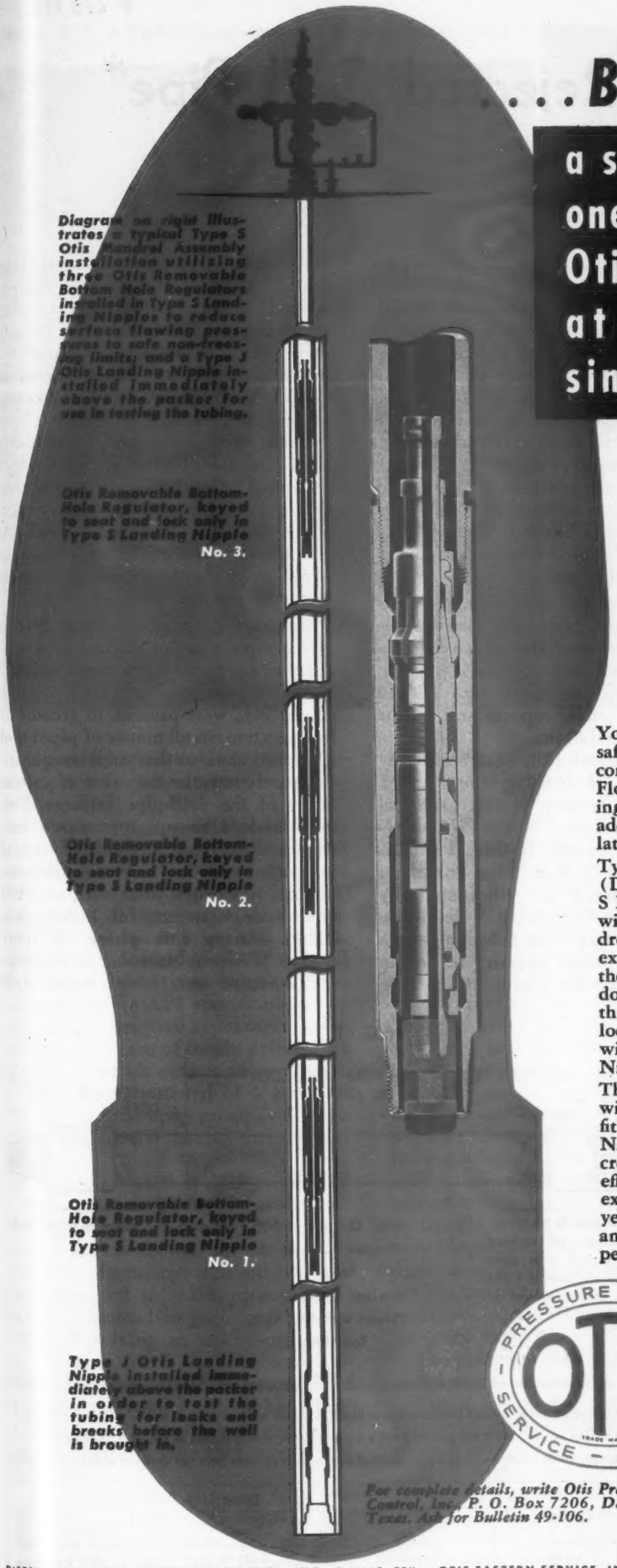

Diagram on right illustrates a typical Type S Otis Mandrel Assembly installation utilizing three Otis Removable Bottom Hole Regulators installed in Type S Landing Nipples to reduce surface flowing pressures to safe non-freezing limits; and a Type J Otis Landing Nipple installed immediately above the packer for use in testing the tubing.

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Field Test on Rejected Drill Pipe*

A. W. THOMPSON† and H. G. TEXTER‡

Abstract. *This paper reviews briefly the innumerable drill-pipe failures encountered in drilling West Texas and New Mexico oil wells. Mention is made of field studies by the Battelle Memorial Institute—indicating that corrosion is the principal cause of the failures and that worthwhile preventive measures are: 1, plastic coating of the inside of the pipe; 2, using inhibitors in the drilling fluid; and, 3, keeping the pipe in tension by the use of drill collars. Battelle also studied the effect of mill defects, but arrived at no conclusion as to their influence in causing failures.*

The paper then describes a field experiment in which a 5300-ft string of 4½-in. drill pipe, made up entirely of mill rejects, was used to drill West Texas "salt-string" holes, ranging from 800 ft to 4500 ft in depth. The lengths were not internally coated; no inhibitors were added; and only a minimum of drill collars was employed. In drilling 20 wells (a total of 46,458 ft of hole) 21 drill-pipe failures occurred, none being in a mill defect. Each failure was the result of corrosion fatigue.

The conclusion is drawn that "seams," "laps," "pits," "plug cuts," "inclusions," etc., even up to twice the depth allowed by API specifications, as represented in this test, have no effect on the service life of drill pipe. It is suggested that high-pressure testing of drill pipe might be better assurance of serviceability than surface inspection.

DURING the war years there was great drilling activity in the Permian Basin of West Texas. Partly because of the depth, partly because the formations were hard, but particularly because of corrosion, there was a large number of drill-pipe failures.

Knowing that steel mills, including the pipe mills, were pressed for materials, labor, and delivery, it was natural that many of the troubles were attributed to "wartime steel," and the pipe manufacturers were severely criticized for shipping material inadequate for the service. This was emphatically denied; but, to settle the matter, an independent study was made.

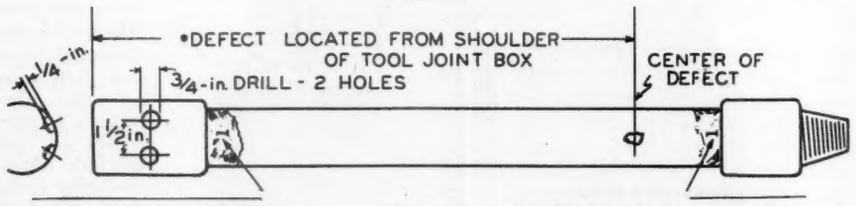
The American Association of Oilwell Drilling Contractors (AAODC), in 1945, employed the Battelle Memorial Institute[1] to study the problem for them, to determine the exact cause of the drill-pipe failures, and to learn what could be done about alleviating them. The study was carried on in a very systematic manner, through field and laboratory investigation; and the results were published from time to time in the *Drilling Contractor*, official AAODC publication.

Many specific and valuable facts were learned, and the conclusions probably justified the expense. It is recommended that all users of drill pipe in corrosion-fatigue areas should study the Battelle reports and follow its recommendations.

It was learned quite early (see May 1946 issue of *Drilling Contractor*) that "... corrosion is the principal contributing factor to the short service life of drill pipe in this (Permian Basin) area"; that "the corrosion problem cannot be eliminated by changing the chemical analysis of the pipe"; and that "the solution to the internal corrosion appears to be the use of a protective (internal) coating or chemical treatment of the drilling fluid." A little later it was demonstrated, and rightfully, that keeping the drill pipe in tension, with enough drill collars to more than equal the weight on the bit, was the greatest single factor in reducing corrosion-fatigue failures. This practice has been recommended in the past, particularly by Grant and Texter, in their paper presented before the Institute, November 6, 1941,[2] but was not too generally followed until around 1945. At about this same time experimental strings of plastic-coated drill pipe were first put into the field.

One factor, viz., that of mill defects in the pipe, was not studied to a conclusion. Everyone knew that "seams," "laps," "pits," "plug cuts," "inclusions," etc., were present, to greater or lesser extent, in all makes of pipe; and it seemed obvious that such irregularities surely must be the cause of a great many of the drill-pipe failures. Battelle made a thorough research into various inspection methods, electrical and otherwise, for detecting defects, but did *not* prove what sort, or what magnitude, were harmful. In fact, they stated, during this phase of their study: *"There is no value in developing sensitive tests which reject drill*

FIG. 1.



Each length of pipe to be identified by a number steel stamped on machine surface over upset part. Numbers will start at 1 and advance to total number of lengths furnished.

4½" O.D. — 16.60#
Grades "D" and "E"
Range 2
Internal Upset Shrink
Thread with 5¾" O.D.
Tool Joints.

Same as other end.

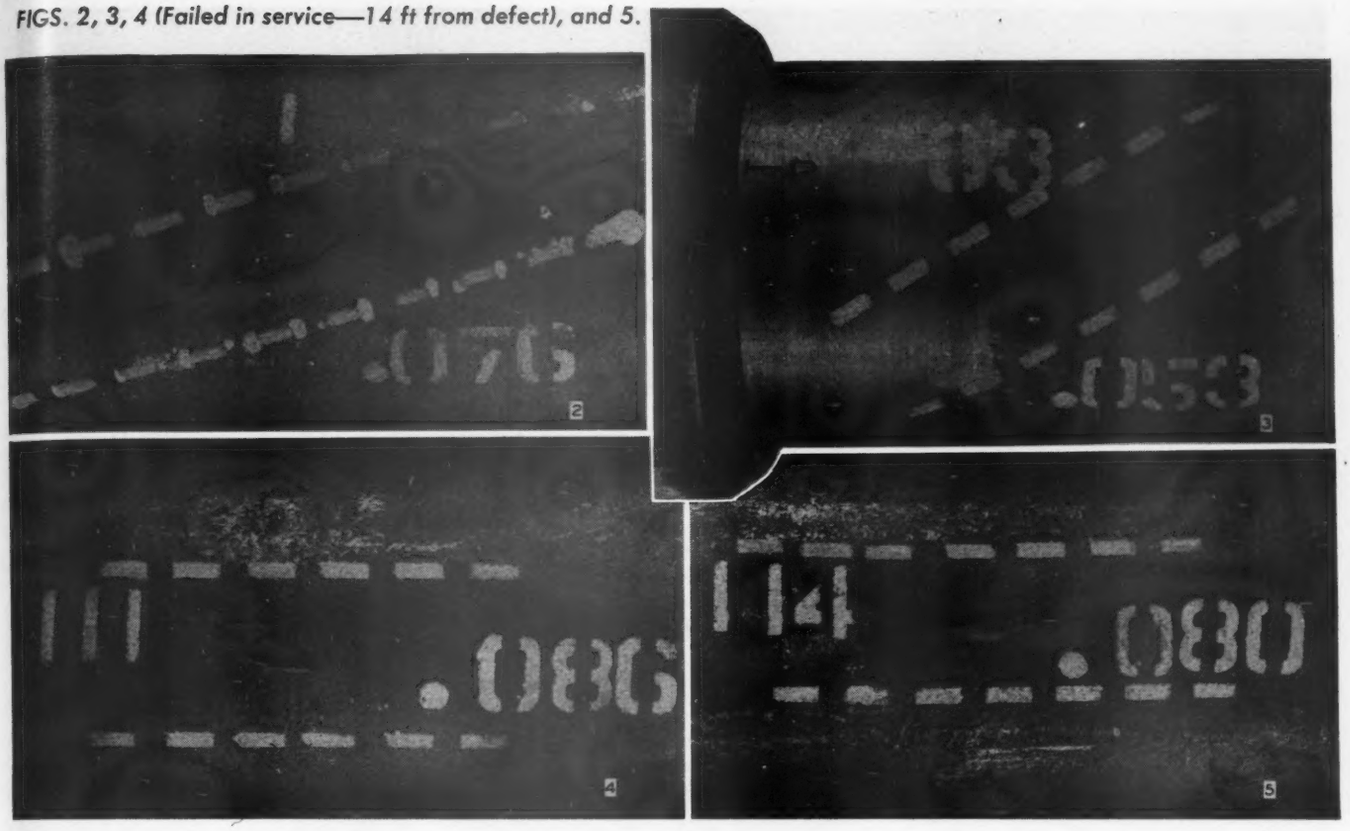
*Defect (one only per length) will be located from shoulder of box. Dimention will be exact—ft and in.—to center of flaw. A photograph will be taken of each defect and picture given a number corresponding to that on the length having defect. Table will be made up recording length no., type reject, depth of defect, exact distance from box to center of flaw. For example

Length no.	Grade	Defect		
		Type	Depth	Location
1	D	Outside pit	0.031 in.	12 ft 6 in.
2	E	Outside seam	0.040 in.	21 ft ¼ in.
3	D	Inside seam	Not measured	Approximately 16 ft
etc.	etc.	etc.	etc.	etc.

*Presented before a meeting of the Division of Production Committee on the Standardization of Oil-Country Tubular Goods, during the 28th Annual Meeting of the American Petroleum Institute, in the Stevens Hotel, Chicago, Illinois, November 8, 1948.

†Thompson-Carr, Inc., Houston, Texas.
‡Spang-Chalfant Division, The National Supply Company, Tulsa, Oklahoma.

FIGS. 2, 3, 4 (Failed in service—14 ft from defect), and 5.



pipe for defects which have no influence upon its performance or its operating life."

It is the purpose of this paper to throw a little more light on the subject of mill defects. It concerns an actual field test, carried on by the respective companies of the authors, of a string of drill pipe made up of mill rejects. Each length would have been rejected because of defect greater in depth than allowed by the API specifications, or because of their bad appearance, especially in the case of inside defects, the depths of which cannot be measured.

The string consisted of 4½-in.-OD 16.6-lb internal-upset range-2 drill pipe with 5¾-in.-OD shrink-thread tool joints:

144 lengths—4181 ft API grade "D"
39 lengths—1124 ft API grade "E"

The pieces were selected at random, as the rejects showed up during routine manufacturing; and either grade was accepted to make up a 5300-ft string. Inasmuch as each length was a reject, involving an unknown hazard to the user, each one was tested to 5000 psi hydrostatic pressure, held for 5 sec and rattled with air hammers. Of the lengths tested, not one failed under pressure. No other special test was applied.

The string was shipped from the mill, May 2, 1947, to Thompson-Carr, Inc., at Odessa, Texas, and put into service, June 13, 1947. It was used only in drilling the "salt-string" hole, 11-in. or 12¼-in., into which the intermediate casing string, 8⅝-in. or 9⅝-in., was set, to case off the Permian beds. These range from 800 ft to 4500 ft in depth. In these strata are found the salt and anhydrite sections which Battelle,[1] and others, have shown to be the principal cause of corrosion fatigue in the Permian Basin.

Although plastically coating the inside of drill pipe would prevent corrosion fatigue, these test lengths were neither shot-blasted nor coated, because the prime purpose of the experiment was to learn the effect of mill defects on failures. Also, only the minimum number of drill collars was used—again for the purpose of giving the defects all possible chance of inducing failures if so disposed.

The crews running this experimental string, having been told only to handle it normally, were at first very skeptical of the defects, because many were so obvious; and they would lay out the worst ones. Gradually they were convinced that there was nothing to worry about.

The principal data on this string are as follows:

Fig. 1 shows the marking system employed for absolute indentification of each length.

Each length was steel-stenciled, at both ends, with numbers running from 1 through 183, stamped near the tool points (over the upsets to obviate notch-fatigue failures).

Each box-end tool joint had 2 drilled holes—¾ in. in diameter, ¼ in. deep, side by side—in the heaviest section of the tool joint.

The principal defect in each length was recorded as a measurement, in feet and inches, from the approximate center of the defect to the makeup shoulder of the box tool joint. Thus, if a complete failure occurred in drilling, and the "fish" were not recovered, the relationship of the failure to the defect still would be known.

All major outside defects were photographed [see Fig. 2, 3, 4, 5, 6, and 7 (photos of lengths 1, 33, 111, 114, 126, and 140)].

Note the grinding-wheel marks, by which the inspectors explored the bottoms of some of the defects.

Classification of defects.

Type of defect and depths (inches)		No.	Per cent
Outside seams	0.021 to 0.042	52	28.4
Outside seams	*0.043 to 0.089	72	39.4
Outside pits	0.028 to 0.040	7	3.8
Outside pits	*0.043 to 0.086	10	5.5
Inside defects	Not measured	42	22.9
		183	100.0

*0.043 in. is just over the API allowable depth tolerance of 12½ per cent of nominal wall thickness. Therefore, 72 seams and 10 pits, or 45.9 per cent of the tubes, were rejectable on this score.

The balance of the outside defects, because of their appearance, would be considered as rejects by all pipe-mill and outside inspectors.

The inside defects, 42 lengths, or 22.9 per cent, also would be rejected by pipe-mill and outside inspectors.

After receipt at the contractor's Odessa, Texas, yard, the lengths were trucked out indiscriminately to various locations—sometimes as a whole

FIG. 6

FIG. 7

string, but at times split into two strings. Records were kept as to footage drilled, and occurrence of failures —without knowledge, naturally, of just how much footage any given length had drilled. Thus, at time of any given failure, the length actually maye have been in its first well or it may have drilled the *total* footage recorded up to that time. This, however, would have no bearing on results of the test.

Table 1 gives some details of the drilling records and occurrence of the pipe failures.

Table 2 is an analysis of the failures with respect to the principal defect. Note that *none occurred in a mill defect.* Each was due to corrosion fatigue.

As failures developed, they were shipped to the Spang-Chalfant research laboratory, Ambridge, Pa., for study. This was to determine the cause of the failures and to learn whether any unreported defect might have been at fault. Apparently nothing but corrosion, plus cracks resulting therefrom, was the cause of every one of the 21 failures.

Fig. 8 and 9 are photographs of the inside of failed lengths No. 40 and 157, showing typical pits and cracks characteristic of corrosion-fatigue failures in drill pipe. Length No. 40 was the third failure, and No. 157 was the fifth failure in the string. As evidence that the drilling fluids were very corrosive, note the degree of pitting in Fig. 9, which shows the inside surface of the fifth failure.

Fig. 10 shows pulling-test strips from these same lengths; and it illustrates how incipient cracks, often not visible to the naked eye, open up under tension. This, the authors consider, is proof that corrosion fatigue was involved.

In most cases not only was the failure itself returned to the laboratory, but also a section of the pipe containing the defect for which the length originally had been rejected. This was done so that possible aggravated corrosion, at the bottom or edges of the defect, could be investigated. In no case was there any evidence whatsoever that an original defect had any influence upon the rate of corrosion.

It may or may not be significant that 12 of the 21 failures were made in grade "E" pipe, although there were only 39 lengths of "E" and 144 of "D". The authors themselves are in disagreement as to whether it proves that one is more resistant than the other or whether the laws of chance happened to operate unconventionally.

At least the authors agree that grade "E" is no better than grade "D" as far as corrosion is concerned, and it is justified only when wells are deep and require high-strength drill pipe for high tensile loads.

On August 29, 1948, this string was

TABLE 1. Drilling record and pipe failures.

Well no.	Days in service	Well description and location	Size hole (in.)	Total depth (ft)	Pipe failures		Number and size of drill collars		
					Length no.	Position in string	No.	In.	ft
1	18⅛	Ratliff Bedford No. 7 Andrews County, Texas	12¼	4250	159	1st length ADC above drill collars	6	8	30
2	2	Sealey-Smith No. 26 Ward County, Texas	11	850	..	No failures	1	8	30
3	10	University D-2 Andrews County, Texas	12¼	3700	..	No failures	6	8	30
4	9⅜	Hobbs B-2 Crane County, Texas	12¼	2060	164 40	2nd length ADC 1st length ADC	4	8	30
5	2⅛	Sealey-Smith No. 30 Ward County, Texas	11	863	..	No failures	1	8	30
6	8⅛	Hobbs B-3 Crane County, Texas	12¼	2122	156 157 163	2nd length ADC 2nd length ADC 2nd length ADC	5 4 4	8 8 8	30 30 30
7	5	University 62 No. 1 Crockett County, Texas	12¼	1550	..	No failures	5	8	30
8	5⅜	University 67 No. 1 Crockett County, Texas	12¼	1540	..	No failures	6	8	30
9	2⅛	Sealey-Smith No. 39 Ward County, Texas	11	815	..	No failures	1	8	30
10	11⅜	University 160 No. 7 Andrews County, Texas	11	3975	..	No failures	6	8	30
11	2⅛	Sealey-Smith No. 38 Ward County, Texas	11	811	161	3rd length ADC	1	8	30
12	2⅛	Thomas No. 4 Ector County, Texas	11	1495	..	No failures	6	8	30
13	1	Sealey-Smith No. 46 Ward County, Texas	11	807	..	No failures	1	8	30
14	6	University 160 No. 8 Andrews County, Texas	11	3050	166 7 11	1st length ADC 3rd length ADC 6th length ADC	6 6 6	8 8 8	30 30 30
15	12⅜	Ratliff Bedford No. 11 Andrews County, Texas	12¼	4250	5 11	1st length ADC 2nd length ADC	6 6	8 8	30 30
16	7⅛	Fraser F-4 Ector County, Texas	11	3695	..	No failures	6	8	30
17	10⅜	Williamson No. 5 Ector County, Texas	12¼	3825	16 171	16th length ADC Not recorded	2 Not recorded	8	30
18	2⅜	Cornell No. 35 Ector County, Texas	11	975	..	No failures	2	8	30
19	4	Thomas G-4 Ector County, Texas	11	1510	..	No failures	2	8	30
20	18⅜	Scharbauer A-10 Ector County, Texas	11	4315	138 94 124 145 160 64 25	19th length ADC 10th length ADC 30th length ADC 9th length ADC 1st length ADC 7th length ADC 12th length ADC	7 7 7 7 7 7 7	8 8 8 8 8 8 8	30 30 30 30 30 30 30

Totals: Wells 20 — Days in service 143 — Footage 46,458 ft — Failures 21 — In grade "E"—12 — In grade "D"— 9

TABLE 2. Mill analysis of failed lengths.

Length no.	API grade	Principal defect				Failure			
		Type	Depth (in.)	Location (ft)	Location (in.)	Location (ft)	Location (in.)	Description	Cause
159	E	Outside seam	0.024	7	11	21	9	Compound fracture	Corrosion fatigue
164	E	Inside plug spiral	.....	12	0	10	8	Crack	Corrosion fatigue
40	D	Outside seam	0.037	19	6	29	3	Compound fracture	Corrosion fatigue
156	E	Outside seam	0.032	4	6	11	10	Compound fracture	Corrosion fatigue
157	E	Outside seam	0.036	14	0	15	0	Compound fracture	Corrosion fatigue
163	E	Outside seam	0.035	11	2½	8	2½	Compound fracture	Corrosion fatigue
161	E	Outside seam	0.044	8	9	12	9	Crack	Corrosion fatigue
166	E	Outside seam	0.032	7	4½	14	7	Crack	Corrosion fatigue
7	D	Outside pit	0.040	13	8½	18	6	Crack	Corrosion fatigue
111	E	Outside pit	0.086	26	10	8	6½	Crack	Corrosion fatigue
5	D	Outside seam	0.044	5	0	10	9	Crack	Corrosion fatigue
113	E	Outside pit	0.060	26	7	25	4	Crack	Corrosion fatigue
16	D	Outside seam	0.030	7	10	19	7	Compound fracture	Corrosion fatigue
171	E	Outside seam	0.048	22	11	13	5	Crack	Corrosion fatigue
138	D	Outside seam	0.046	10	8	26	3	Compound fracture	Corrosion fatigue
94	D	Outside seam	0.025	22	5	*29	0	Compound fracture	Corrosion fatigue
				22	5	*26	10	Crack	Corrosion fatigue
124	E	Outside pit	0.053	7	7	5	6	Crack	Corrosion fatigue
145	D	Outside seam	0.046	28	0	14	8	Compound fracture	Corrosion fatigue
160	E	Outside seam	0.023	12	9	4	4	Compound fracture	Corrosion fatigue
64	D	Inside pit	.....	26†	..	14	8	Crack	Corrosion fatigue
25	D	Outside seam	0.054	3	5	21	6	Compound fracture	Corrosion fatigue

*Two failures in this length. †Approximate.

FIG. 8.
Length No. 40

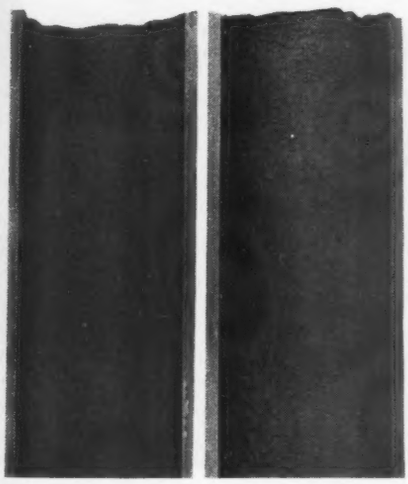


FIG. 9.
Length No. 157

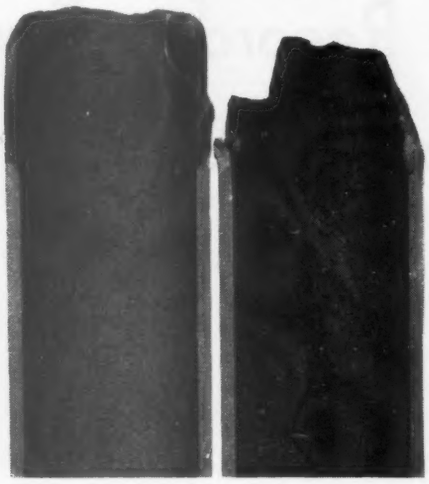
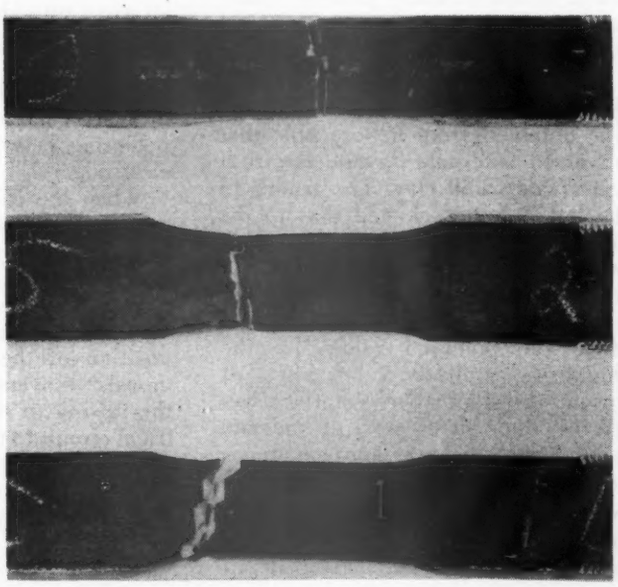


FIG. 10



taken out of service, because of the fact that 7 failures had occurred in the last (twentieth) well, Scharbauer A-10. Although most of the earlier failures occurred close to the drill collars, showing that some of the pipe had been operating in compression, a majority of the failures in the last well occurred well up in the string where the lengths would be in tension. This would indicate that the pipe was now so badly corroded that even mild bending or vibration stresses were causing failures, and it was not deemed practical to run the string any longer. Furthermore, 46,000 ft of hole could be considered a normal life for unprotected pipe in corrosive areas.

Conclusions. Inasmuch as 21 failures occurred in some 46,000 ft of drilling, none of which was even close to a mill defect, it would appear that seams, pits, scores, etc., (inside or outside) are negligible factors even when such defects are as much as twice API allowable depth. If true for the very severe service of Permian Basin drilling, it should be all the more true for the Gulf Coast, the Mid Continent, and all other areas. Therefore, it is the authors' opinion that greater attention should be paid to the care and use of drill pipe than to the question of surface defects. Transverse scars from service use (and abuse) are much more to be feared than mill defects. The latter, being formed hot, are not sharp-bottomed and, therefore, do not act as stress raisers.

There must, of course, be some limit as to the depth or shape or directions of mill defects beyond which we dare not go. It is hoped that others will conduct similar experiments, in the field, under carefully observed conditions, for the purpose of learning just what sort of defects *will* cause failures.

A significant fact is that all of the pipe in this experiment was tested to 5000 psi prior to shipment. It is suggested that a sufficiently high hydrostatic test might be better assurance of adequate strength than measurement of surface defects.

Acknowledgment. The authors are indebted, in preparing this paper, to the hearty cooperation of Messrs. Fred Forster, K. L. Beck, Harry Woodward, and Frank Thompson of Thompson-Carr, Inc., and to Messrs. S. H. Kilmer, William M. O'Donnell, and William F. Schmeling of the Spang-Chalfant Division of The National Supply Company.

1. Battelle Memorial Institute, "Reports to American Association of Oilwell Drilling Contractors," *Drilling Contractor*, throughout the years 1946, 1947, and 1948.
2. R. S. Grant and H. G. Texter, "Causes and Prevention of Drill-Pipe and Tool-Joint Troubles," *Drilling and Production Practice*, 9 (1941).

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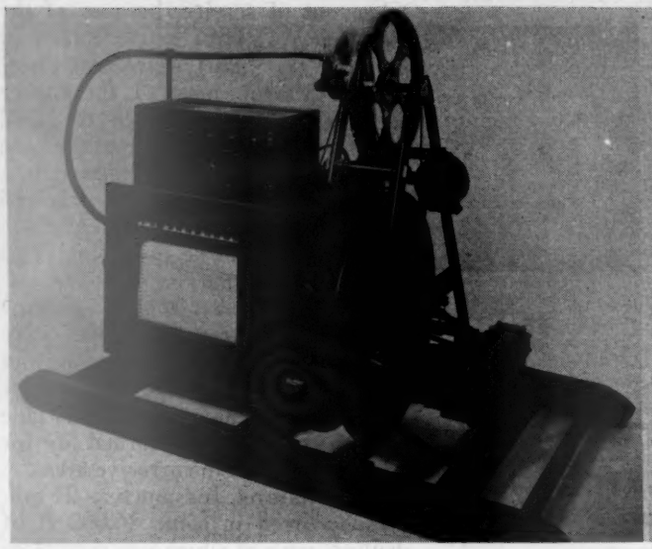


FIG. 1. *Portable electric well logger.*

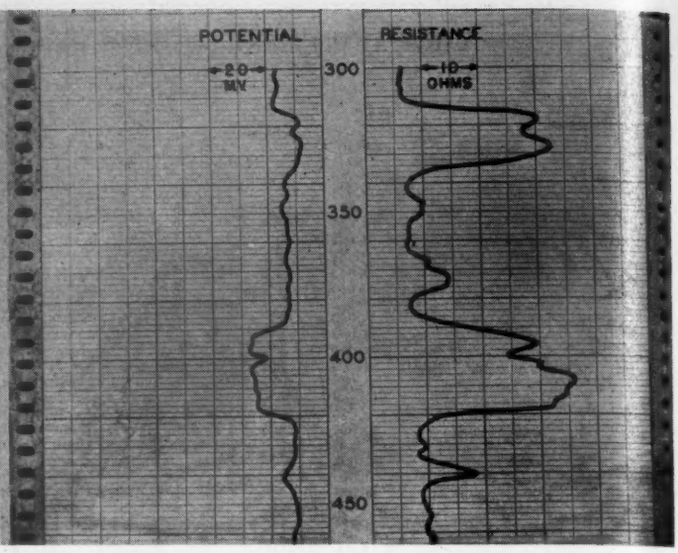


FIG. 2. *Typical electric log obtained with the logger.*

Portable Recording Equipment for Electric Logs

By HUBERT GUYOD*

IN line with the general trend of technological advances in the exploration and drilling phases of the oil industry, are many innovations and improvements. With the increasing demand for more crude and the consequent intensification of exploration activities, the need for accurately recorded data on underground formations assumes paramount importance. One of the more recently developed devices is the recording well logging equipment† described below.

By means of this apparatus, the limits, depths, and sometimes the nature and characteristics of the underground formations traversed by a bore hole, are readily identified upon examination of a recorded graph of the two electrical characteristics that constitute the well log. Comparison and analysis of a group of these logs, obtained from various test holes throughout a field, provide data from which a detailed geological study can be made. In addition the recorded logs may be used to reveal: the depth and thickness of fresh water bearing formations, the location of areas favorable to petroleum accumulations, the location of petroleum reservoirs in wells, and other data.

As shown in Fig. 1, the apparatus utilizes a strip chart potentiometer†† to record the data that constitute the well log. These data comprise an automatically recorded graph of two electrical characteristics, namely resistance and potential, plotted against bore hole depth.

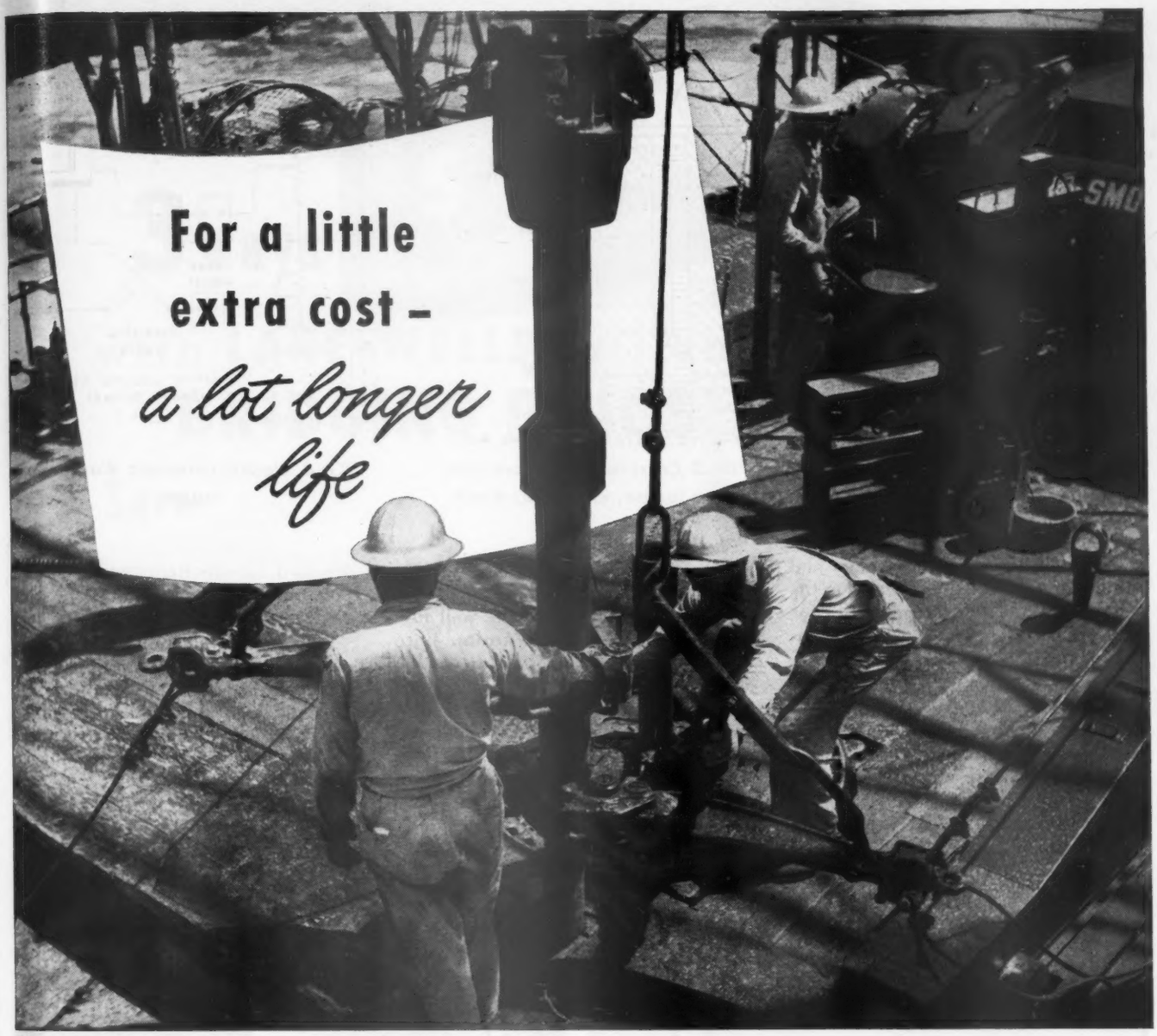
A typical electric log obtained with the logger is shown in Fig. 2. This log was obtained from a bore hole that traversed alternate layers of fresh water sands and clay. The record to the left is potential, and that to the right is resistance. In this log, fresh water sands are characterized by a relatively high resistance and a negative potential in contrast to the resistance and potential values for the clay beds. Similarly, other kinds of formations show representative electrical values that serve to indicate their depth, thickness and sometimes nature.

▶ **Method of Obtaining Log.** Measurement of variations in electrical characteristics throughout the depth of a bore hole is accomplished by means of the arrangement shown in Fig. 3. An electrode, suspended on the end of an insulated electric cable, is lowered by means of a motor-driven winch down the bore hole. Simultaneously, the recorded chart roll is mechanically driven through a pulley, reduction gear train and flexible shaft so as to provide a continuous record of the depth to which the electrode has been lowered. As the electrode is lowered, the potentiometer automatically records the changes in electric potential between ground and the electrode.

When the electrode has been lowered to the bottom of the bore hole, the winch is reversed and the electrode is withdrawn. This action automatically re-rolls the recorder chart and provides a continuous indication of the position of the electrode during its upward movement. Coincident with the raising of the electrode, the electrical circuit to the potentiometer is so altered that resistance changes between ground and the electrode are recorded during the upward travel along side that of electric potential. See Fig. 2.

With this procedure, a complete

*President, Well Instrument Developing Co.
†Widco.
††Brown ElectroniK.



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electric log such as that previously described and illustrated is obtained with a single recorder and requires only one round trip in the bore hole.

The well logger operates from a 110 volt, 60 cycle power source. Where such a source is available at the rig, no power unit is necessary. If power at this voltage and frequency is not obtainable, however, an auxiliary unit available with the logger must be used in order to avoid damaging the logger and recorder by operating it at an improper voltage or frequency.

The method of measuring the potential and the resistance between the electrode and ground is shown schematically in Fig. 4. As represented, an a-c voltage is impressed between the electrode and ground. By means of a rectifier, selector switch, basing circuits, scale selector, and other control components, the potential and resistance between the electrode and ground are corrected and scaled to the required range and characteristics for measurement by the recording potentiometer.

The potentiometer provides an accurate bridge circuit for continuously measuring and recording the electrical characteristics obtained at the control panel. The fast response, sensitivity and speedy recording action of this style recorder are essential to the reproduction of a serviceable well log.

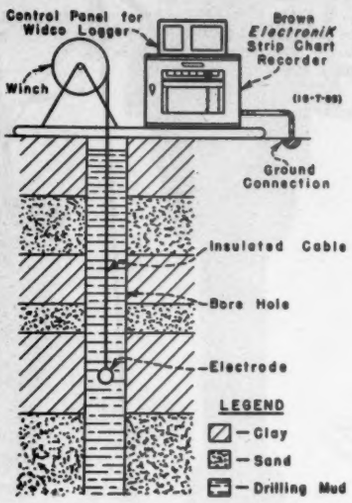

FIG. 3. Cross section of bore hole shows logger, electrode, winch.

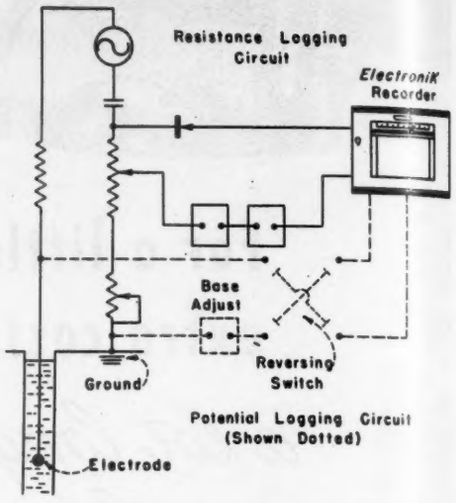

FIG. 4. Electric schematic diagram of logger.

▸ **Bore Hole Depth Limits.** Bore hole depths down to 4000 ft can be logged with self-contained models of the well logger. For deep wells, models are available that utilize a cable installed on one of the reels of the core drill rig. For such wells, two recorders are used for simultaneously recording potential and resistance as the electrode is lowered down the bore hole.

For most applications, such as seismographic shot holes and the like, the self-contained portable model is employed. With this model, a motor-driven winch with 2500 ft of insulated cable is incorporated in the logger.

* * *

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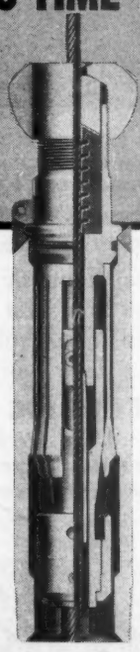

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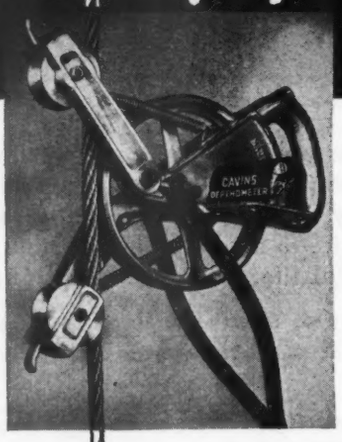

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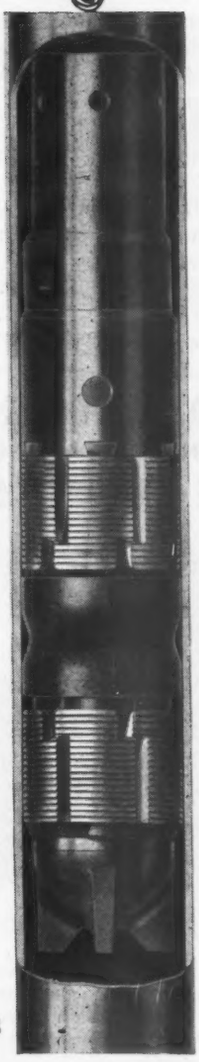

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NEWS

Getty Obtains Concession

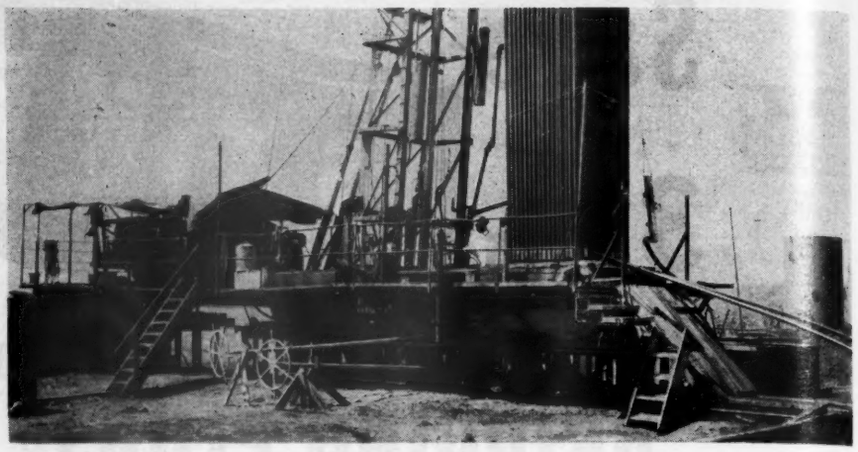
Pacific Western Oil Corporation has obtained an oil concession covering the Saudi Arabian half of a 2200-sq-mi neutral zone on the Persian Gulf, President J. Paul Getty has announced. The other half interest had previously been awarded by the Shiek of Kuwait to the American Independent Oil Company.

Getty said geophysical exploration of the area would get under way immediately, with materials and men being flown into the concession, and that actual drilling operations may start within a month or so.

An oil refinery will be built in the concession zone if conditions warrant such facilities, he said.

The only statement Getty made regarding provisions of the concession was that all royalty and other payments would be made in United States currency.

According to authoritative news sources, however, terms of the concession provide for much larger payments to King Iba Saud than are stipulated in any other concession heretofore granted in the Middle East.



Briscoe-Clingman Drilling Company of Oklahoma City has used this portable rig on well work-over projects that called for deepening below 10,000 ft.

Sign Mexican Contract

Edwin W. Pauley, American Independent Oil Company headed by Ralph K. Davies, and the Signal Oil Company headed by Samuel B. Mosher signed a 25-year contract to help Mexico develop new petroleum resources. The American companies will be responsible for all expenses of exploration and drilling in southeastern Mexico in the states of Vera Cruz and Tabasco.

Although the contract is for 25 years, the companies must complete all drilling activities during the first 12 years. Three structures were specified for exploration and a Pauley spokesman said wildcat drilling operations on these structures would begin as soon as possible.

Pemex will retain control and supervision over the work of the contractors and of the development of the wells. The oil operators will not be repaid unless production is developed; then they will receive 50 per cent of the oil for expenses plus a 15 per cent profit allowable.

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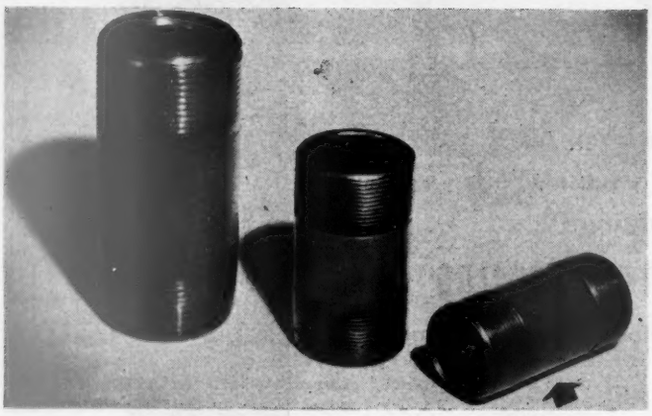

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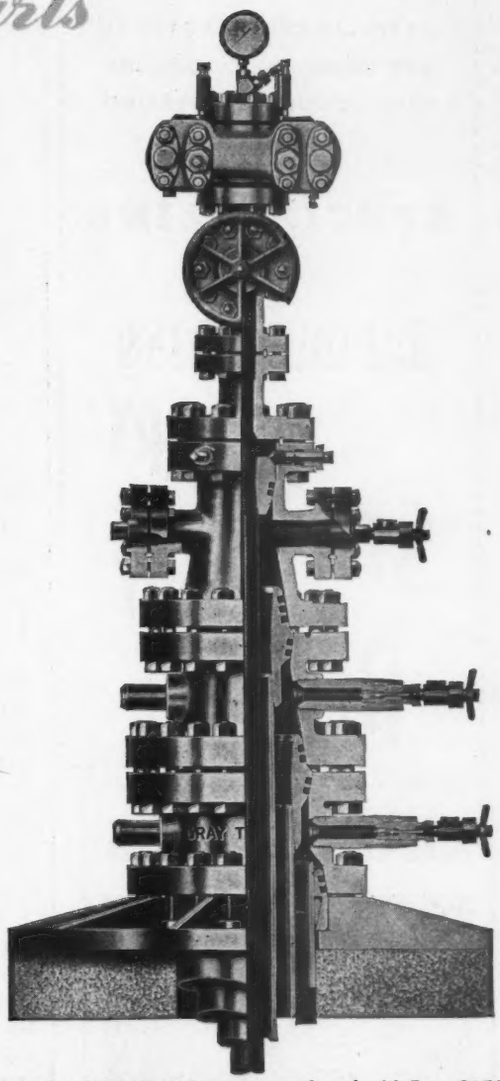

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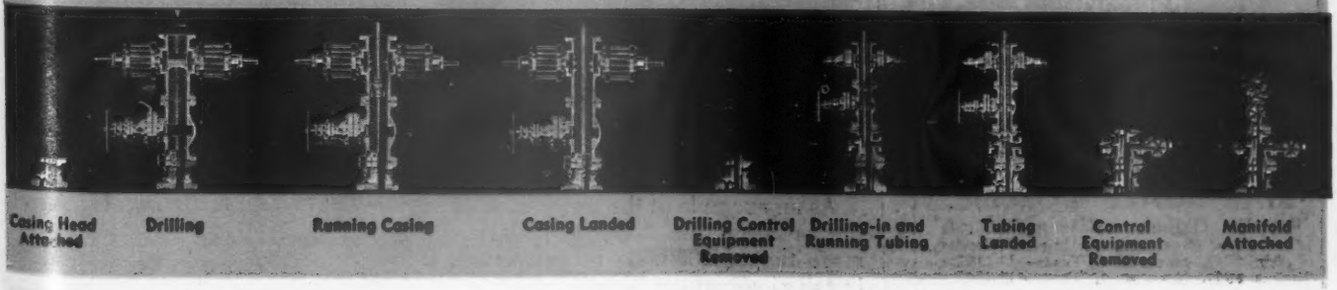

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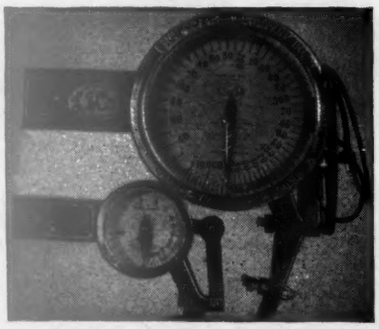

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W. G. Lane Dies

Wilfred G. Lane, inventor, civic leader, and co-founder of Lane-Wells Company, died March 3, 1949, at Hollywood Presbyterian Hospital, California. Mr. Lane retired from the company which bears his name some

Wilfred G. Lane

ten years ago, and had in the meantime applied himself largely to boys work and to other philanthropic interests in the Los Angeles area. He was especially active in Boy Scout and YMCA affairs.

He was born in Mason City, Iowa, majored in electrical and mechanical engineering at Iowa State College, and thereafter was associated for about 20 years with General Electric Company in Schenectady, N. Y. He was also for a time western district manager of Carboloy, Inc., Later he became interested in gun perforation and held several patents relating to the process.

He had known Walter T. Wells back in college days and in 1933 the two combined forces in the organization of Lane-Wells Company to devote themselves to divers technical oil field services. He retired from the company in 1938, made his home in Eagle Rock, California, and from that time until his death applied himself to his favorite humanitarian interests. He was a member of Elks, Kiwanis, Rotary, and Wilshire Lodge 455 F. & A. M. He is survived by his widow, Mrs. Hazel Thorn Lane, and three sisters.

Island Shift Damages Wells

Terminal Island in Los Angeles harbor has been sinking for some time and in July geologists noted a lateral movement at a depth of 1630 ft. In recent weeks this shift became more pronounced, causing damage to 35 to 50 wells in this highly productive area. Reinforcement of casing was required to keep 22 wells in operation.

As an example of the seriousness of the problem, the Navy is spending more than $2,000,000 to protect its installations on the island.

Tidelands Sector Surveyed

About 9000 sq mi in the Gulf of Mexico, off the coasts of Texas and Louisiana, have been mapped in the first detailed magnetic survey ever conducted over water, the Interior Department's geological survey has reported. Results have been published in two aeromagnetic maps with short accompanying text. The survey was undertaken to determine whether Shoran, a short wave radio navigation aid, would work successfully over water in guiding and locating surveying aircraft.

JENSEN—Adaptable
Versatile
Efficient

Jensen is a pumping unit that takes practically any pumping problem in its stride. It operates efficiently on the power that is most convenient and economical in your field. It can be adjusted to balance any well with ease and economy. It is readily adaptable for varying stroke lengths and pumping speeds . . . to changes in power and capacity. This easy versatility of Jensen Pumping Units means better pumping performance, less "downtime"—economical insurance against costly work stoppages.

It will pay you to investigate Jensen. Your near-by Jensen dealer has convincing proof of Jensen versatility, or write to Coffeyville for illustrated, fact-filled literature. Do it today.

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4 reasons why CORROSION ENGINEERS PREFER TUBE-KOTE

1 DIELECTRIC STRENGTH

The thickness of "TK-2" thermo-setting (baked-on) plastic coatings are accurately controlled for the maximum dielectric strength. In the above view a Tube-Kote inspector is gauging the coating thickness on sucker rods.

2 THOROUGH INSPECTION

With the use of recognized optical instruments internal surfaces of all tubular goods receive the most thorough and careful inspection to assure uniform cleanliness and proper base metal preparation.

3 RIGID PLANT CONTROL

Each and every phase of the Tube-Kote process, from the initial cleaning, through sandblasting, coating and baking in several steps is a matter of rigid plant control—thus assuring the highest degree of uniformity and quality.

4 AUTOMATIC EQUIPMENT

The Tube-Kote plant is equipped with many improvements in automatic mechanical facilities. Among these is the Tube-Kote fully automatic internal coating unit shown above, which applies a carefully controlled film in each coating operation.

TUBE-KOTE

First Name In Corrosion Resistance

2520 HOLMES ROAD . . . P. O. BOX 8123, HOUSTON, TEXAS

WIRE, PHONE OR WRITE FOR TUBE-KOTE TECHNICAL SERVICE BULLETIN

Set Meeting Dates to 1951

The Texas Mid-Continent Oil and Gas Association has announced a three-year schedule for its annual meetings to avoid conflicts with fall meetings of other segments of the petroleum industry. The 1949 session is set for Houston, October 13 and 14, and the 1950 meeting, October 4 and 5, will be in Dallas. The Association has accepted an invitation from Beaumont citizens to meet there in 1951, the fiftieth year since the Spindletop discovery.

New Officials

Orien W. Van Dyke has been promoted to vice president of Magnet Cove Barium Corporation, producers

O. W. Van Dyke

G. H. Moore

E. H. Lancaster, Jr.

of Magcobar drilling mud products. Van Dyke graduated from Iowa State College with a degree in Chemical Engineering and joined the Philadelphia Quartz Company to promote the use of sodium silicate in the oil fields. He joined Magcobar in 1944 as chief engineer and in 1946 was made distribution manager.

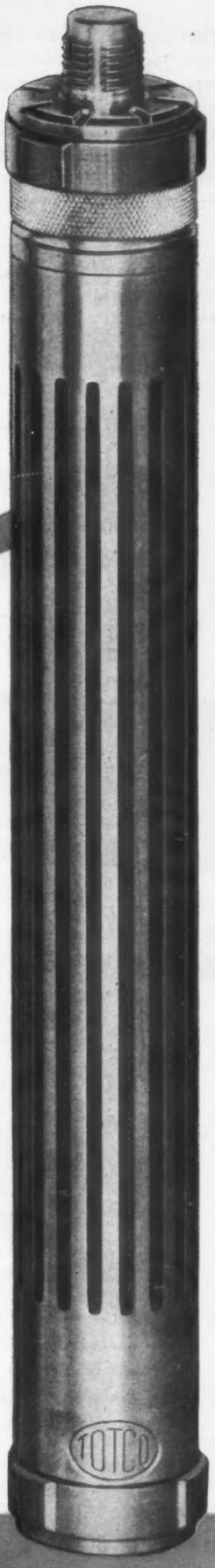
George H. Moore, a graduate of Texas A & M College who served as a Colonel in the United States Army, has been named sales manager. For a number of years prior to his army career and afterward until he joined Magcobar, he was associated with Baroid Sales Division of The National Lead Company.

E. H. Lancaster, Jr., for 13 years in the drilling engineering and drilling mud engineering department of Humble Oil and Refining Company, has joined Magcobar as manager of field service.

It is estimated that 82 per cent of rotary drilling rigs are owned and operated by 500 drilling contractors.

The *little instrument* that pays *big dividends* in fast, efficient, money-saving

CONTROLLED VERTICAL DRILLING



Throughout the United States, and in every oil-producing country of the world, the combination of Totco Recorders and controlled vertical drilling methods saves the oil industry many millions of dollars each year through avoiding crooked holes. Although a Totco is one of the smallest items of equipment at a drilling job — and its cost is negligible in the overall cost of any well . . . this little instrument supplies the accurate information that enables the driller to *control* the bit and keep it on a vertical course. Yes,

Sand line, measuring line or bailer
RUN 5 WAYS
Retrieved with wire line coring equipment
Dropped freely in drill pipe
TOTCO

TOTCO RECORDERS

pay big day-by-day dividends in fast, efficient, money-saving Controlled Vertical Drilling of wells to any depth, in any formations, everywhere.

Ask the operators who use Totco Recorders in thousands of wells each year, or send for complete information.

Totco Equipment is leased or rented in the U.S.A.; sold for export only.

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Taylor Scores Over-Specialization in Oil Industry

Over four hundred petroleum engineers participated in the Petroleum Branch activities of the AIME annual meeting in San Franciso, February 13-17. Registration lists showed those present to be from all over the United States, with a few foreign countries represented.

A keen interest in the Petroleum Branch meetings was evidenced by the large groups attending the production review February 14, economics session on the 15th, and technical paper presentation on the 16th. Three economics papers and eight technical papers were presented.

One of the highlights of the four-day meeting was the Petroleum Branch annual dinner, attended by 220 members and guests.

Reese H. Taylor, president of Union Oil Company of California and principal speaker for the banquet, held the fascinated attention of his audience with a satirical analysis of specialization in the oil industry, entitled "The Greeks Had a Word for It." Starting with the premise that matters pertaining to oil are handled with considerable science today, he carried his listeners through the various steps in producing oil. When a new area is to be explored the chief geologist in the company is consulted. He has analyses made, and finally turns in a 70-page report containing 22 maps. This shows that structures vary widely in the area, and it is decided that it should be studied by a micropaleontologist.

The micropaleontologist studies the area and draws a paleogeographic map, from which he develops a 5-lb report. This leads to doubtful conclusions on the area and the decision that it should be explored by geophysical methods. The flying magnetometer is then employed over the area, which leads to it being checked by a gravity meter. It is then shot by reflection seismograph.

After the legal department has mulled over the lease for a considerable period the well is spudded. All of the steps of consulting core specialists, mud engineers, and taking gamma ray logs, electric logs and neutron logs are then accomplished. Finally, the well is complete and a recap shows that 35 different specialists were engaged in order to get a well that will produce 35 bbl of 35 gravity oil. Taylor concluded by stating the moral that people engaged in producing oil should not become so specialized that they lose sight of the over-all objective of providing beneficial products and services for people.

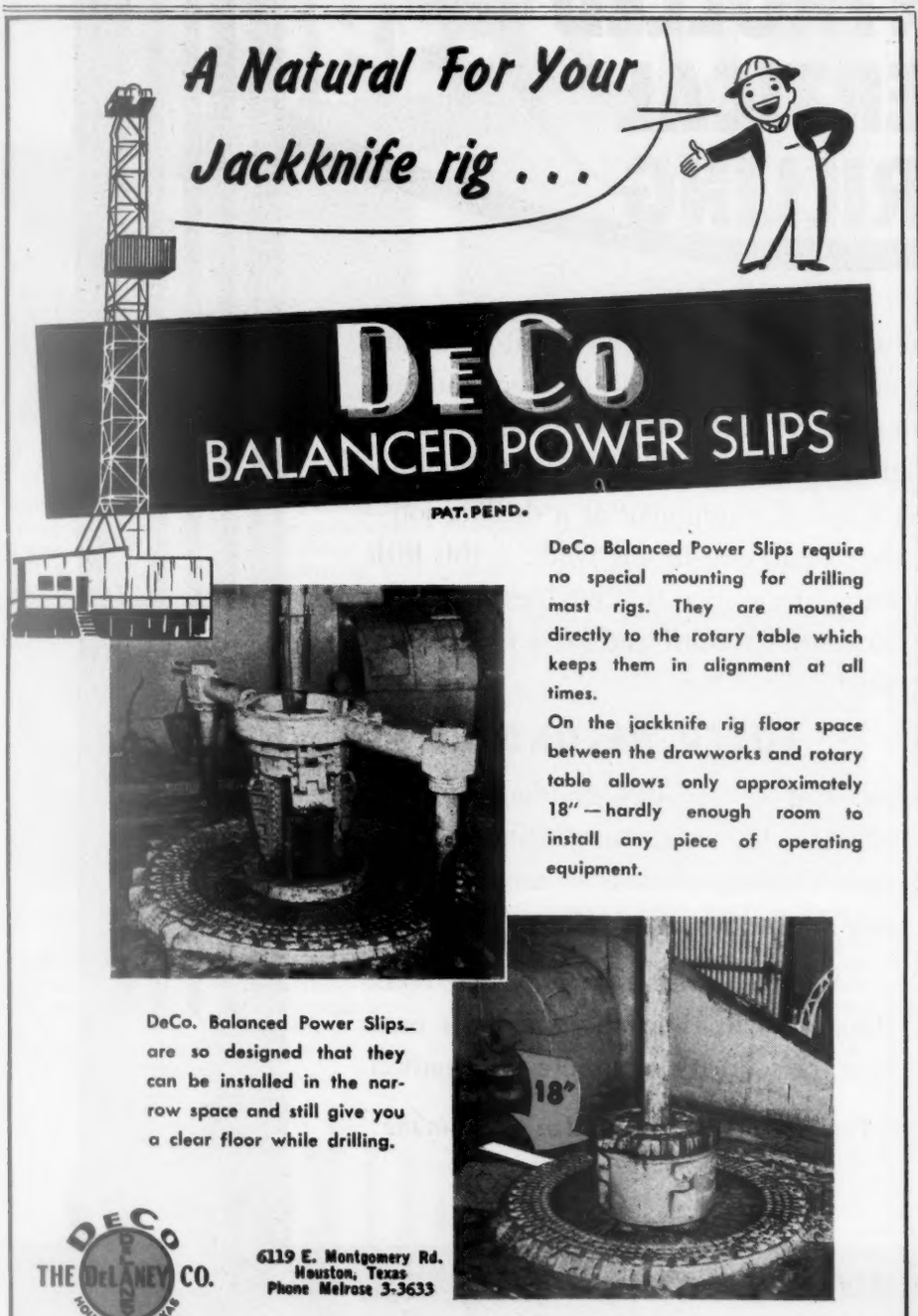
Lloyd E. Elkins, incoming chairman of the Petroleum Branch, presided at an executive committee meeting Thursday morning, February 17. It was decided at this meeting that the Petroleum Branch would publish a directory of its membership in one of the mid-year issues of the *Journal of Petroleum Technology*. This decision was made because the usual annual directory of AIME will not be published in 1949.

Oil Scouts Yearbook

The National Oil Scouts and Landmen's Association is now taking orders for its 1949 Yearbook, which covers oil operations in all the producing states for the year 1948. Orders should be addressed to the association general secretary, P. O. Box 1095, Austin, Texas.

Jet Perforating in Venezuela

Seismograph Service Corporation of Delaware, Tulsa, and Welex Jet Services, Inc., Fort Worth, completed the first jet perforating job in Venezuela in mid-February in the Saban field near Tucupido. The perforation of casing by the method employed was developed by Welex and was described in an article beginning on page 129 of the August, 1948, issue of *The Petroleum Engineer*.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Jackknife rig . . .
DeCo
BALANCED POWER SLIPS
PAT. PEND.
DeCo Balanced Power Slips require no special mounting for drilling mast rigs. They are mounted directly to the rotary table which keeps them in alignment at all times.
On the jackknife rig floor space between the drawworks and rotary table allows only approximately 18" — hardly enough room to install any piece of operating equipment.
DeCo. Balanced Power Slips— are so designed that they can be installed in the narrow space and still give you a clear floor while drilling.
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DeCo oil field equipment sold through leading supply stores.
DeCo Balanced Power Slips
DeCo Carbon and Alloy Forgings
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in Cabimas, Venezuela, SCHLUMBERGER ran

the first electrical log ever recorded

in the Western Hemisphere.

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VICTAULIC COUPLINGS add flexibility to any piping system—allowing pipe lines to follow construction and land contours without costly, engineered-alignment.

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. . . and they have a two-bolt simplicity of construction that lets pipe lines be assembled *without specially trained labor—and with a standard T-wrench the only tool needed.*

VICTAULIC FULL-FLOW ELBOWS, TEES, and other Fittings have wide-sweeping turns and true-circular inner walls that reduce frictional losses to a minimum . . . increasing pipeline output *at lower pumping costs!*

AND OUR "VIC-GROOVER" grooves pipe ends twice as fast—*with only half the effort of ordinary pipe threaders!*

WRITE TODAY for these two: Victaulic Catalog and Engineering Manual No. 44 . . . "Vic-Groover" Catalog No. VG-47.

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EFFICIENT FULL-FLOW FITTINGS

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Excessive Supply Being Cut

Both imports and domestic production are being reduced to bring crude supply into a more favorable balance with demand. It has been announced that Standard Oil Company (New Jersey) has taken action to reduce its imports from the Middle East from 1948's 4th quarter average of 88,000 bbl daily to a 40,000 bbl daily average in the 1st quarter of 1949 and to 34,000 bbl in the 2nd quarter. The tanker time from this area being four to six weeks, the first effects of this reduction has only recently been noticed.

More immediate in its effect and much larger in quantity is the decrease in domestic production, Texas having reduced its allowable more than 500,000 bbl daily during the past three months. Texas was joined in this reduction by Oklahoma, Kansas, New Mexico, and finally in March by Louisiana, totaling nearly 100,000 bbl decrease since year's end. Mississippi and Wyoming have been forced into curtailing production when purchases of low gravity crudes were slashed. Baxterville Field in Mississippi fell from first to seventh place as a crude producing area in the state when Gulf Refining Company cut purchases by two-thirds. The lower than anticipated heavy fuel oil demand, the same basic reason for Creole Petroleum Company's 100,000 bbl daily cut in Venezuela, has left these heavy crudes, along with West Texas sour crude, a drug on the market.

To Open Canadian Office

O. W. Morgan, Jr., general sales manager of Byron Jackson Company, and John B. Merritt, assistant general manager of Patterson-Ballagh, division of Byron Jackson, have recently returned from an extensive trip in Canada. Their observation of the vast drilling development around Calgary and Edmonton has resulted in a sales engineer being ordered to Edmonton April 1.

Kuwait Production

Although down somewhat from the December peak, production of crude oil in Kuwait was near the 200,000 bbl per day level during January. In 1948 production averaged 120,330 bbl per day, which was well over two and a half times the rate of preceding year.

Offices Moved

Schlumberger Well Surveying Corporation has announced the removal of its Dallas offices from the Continental Building to 1018 M&W Tower Building. This office is operated by R. I. Seale and L. A. Puzin.

With SHAFFER CELLAR CONTROL GATES

ot only can you vary the type of power, but also the power drive!

Choice of Air—Hydraulic—Steam or Electric Drives . . . plus Remote or Unitized Hook-Ups—all with full manual standby!

Here's one cellar control gate that has virtually no power limitations whatever. Not only can you operate a Shaffer Cellar Control Gate interchangeably with *any* type of power found in today's field operations—air, hydraulic, steam or electric—but you also have a wide choice of hook-up arrangements to meet the individual requirements of each rig. And with all installations you have the added safety of full manual standby. Shaffer Gates stand alone in wide-range adaptability to every field condition!

FOR EXAMPLE, **Take the Shaffer air drives**

If you want the power drive located *away* from the Gate then this Shaffer Dual Air Motor Drive is the hook-up you want. By means of an air-operated clutch its *single* Shaffer Air Motor will close and open *both* ram assemblies in a Shaffer Double Gate (or *two* Shaffer Single Gates), and it can be located either on the mat or completely outside the rig, from where it operates the rams by means of positive torque-tube drives.

Only two small air valves, mounted convenient to the driller, are needed to control all Gate operations. One valve, connected to the Air Motor by means of two simple pipe lines, operates the Air Motor in either an opening or closing direction.

The other valve, connected to the air clutch by two flexible tubing lines, selects the Gate to be operated . . . and by pre-locating this valve on the Gate desired, only *one* valve need be operated when pressure emergencies occur, reducing control operations to a minimum.

And remember—like all Shaffer Power Drives—this one has the added protection of *full* manual operation (both closing and opening) should power failures occur. The power drive is *automatically* disconnected when not in use, thus eliminating motor drag when operating the Gates manually.

If you prefer to have the power drive close to the Gate here's the Shaffer Air Motor Drive arrangement that fills the bill. On this hook-up a separate Shaffer Air Motor Drive is used for operating each ram assembly of a Double Gate (or for each single Gate), and is side-mounted directly on the Gate body and operates through a positive chain drive. A special air valve for closing and opening the Gate is installed convenient to the driller for operating each Air Motor and its air clutch. Manual closing of the Gates is accomplished in the same manner as in the Shaffer Dual Air Motor Drive described at left . . . and similarly, the Air Motors are *automatically* disconnected when not in use to eliminate drag during manual operation.

This Shaffer advantage of *complete* manual standby—both for closing and opening operations—is particularly important should power failures occur during pressure emergencies. Shaffer alone provides such vital *double* protection to safeguard your wells!

Complete Interchangeability!

Simple to install and completely adaptable, Shaffer Power Drives have the further advantage that they are quickly interchangeable. You can move a Shaffer Cellar Control Gate from well to well, and by simply changing the compact power drive, you can operate the Gate with air, hydraulic, steam or electric power—whichever is most convenient for each installation . . . *always with the added safety of manual standby!*

Before you buy *any* Cellar Control Gate equipment be sure to get the full story on Shaffer's *many* important advantages. Send for your free copy of the Shaffer Catalog which outlines other vital features.

See the Shaffer section of your Composite Catalog.

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS, Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6006 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

Office Drilling

Karl Kellogg of K. L. Kellogg and Sons was presented with a model rig recently by members of his organization. The present was a scale model of an actual drilling rig and stands just over 7 ft high with a 17-in. base. The hoist is a 3-shaft, 2-speed model with a rotary table take off on the jack shaft. All drives are driven by chains and power is obtained through a reduction gear driven by an electric motor. The rig includes a 3-sheave traveling block, 4-sheave crown, rotary table, kelly, swivel, pipe racks, tool docks and attendant appurtenances. The hoist is equipped with catheads and three jaw clutches for the necessary drilling operations.

So far drilling operations have been confined to making up drill pipe and rotating, although any day the staff expects the surface formation of tile, wood and concrete to be penetrated. Visitors regardless of their business are given a thorough demonstration of the rig with "K. L." at the brake. Just one hitch has occurred in the operations and that has been a safety inspection by the Division of Industrial Safety with a "Discontinuance Tag—Use Forbidden" placed on the rig. The staff is now busy complying with the safety recomendations.

Pampa Store Manager

S. M. Miller has been named manager of the Pampa, Texas, store of Oil Well Supply Company, U. S. Steel subsidiary, and C. V. Black has succeeded him as manager of the store at Abilene, Texas.

Iranian Production Up

Crude oil production during 1948 in Iran totaled about 24,870,000 tons, or 523,221 bbl daily. This represented an increase of 23 per cent over the preceding year.

New Area Opened in Indiana

A new oil producing area has been opened about 4 miles southeast of Mt. Vernon, Indiana, in Posey County. The Mitchell and Heppard No. 1 Thomas ran a satisfactory test in the Cypress at 2361-6 ft.

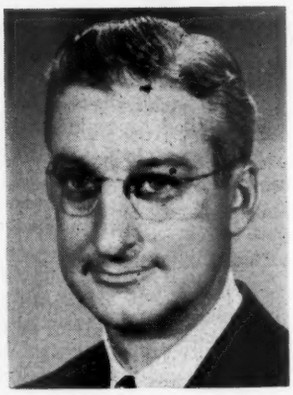
Revive API Chapter

The Western Kansas Chapter of the American Petroleum Institute, dormant since 1944, was recently reactivated at a meeting in Great Bend, Kansas. The chapter area includes the six counties of Barton, Ellis, Pratt, Rice, Russell, and Stafford.

Lloyd Pickrell, vice chairman (Kansas) of the Mid-Continent section of API presided at the organization meeting. Officers elected to serve during the ensuing year include Chairman W. D. (Bill) Maxwell, superintendent of Great Bend district, The Carter Oil Company; vice chairman: Clayton Nygaard, assistant district superintendent of Sohio Petroleum Company, Forest Crawford, production superintendent of Bay Petroleum Corporation, and Vernon Hayes, production superintendent of Lion Oil Company; and Secretary-Treasurer E. E. McDonald, Kansas manager for Union Tank and Supply Company.

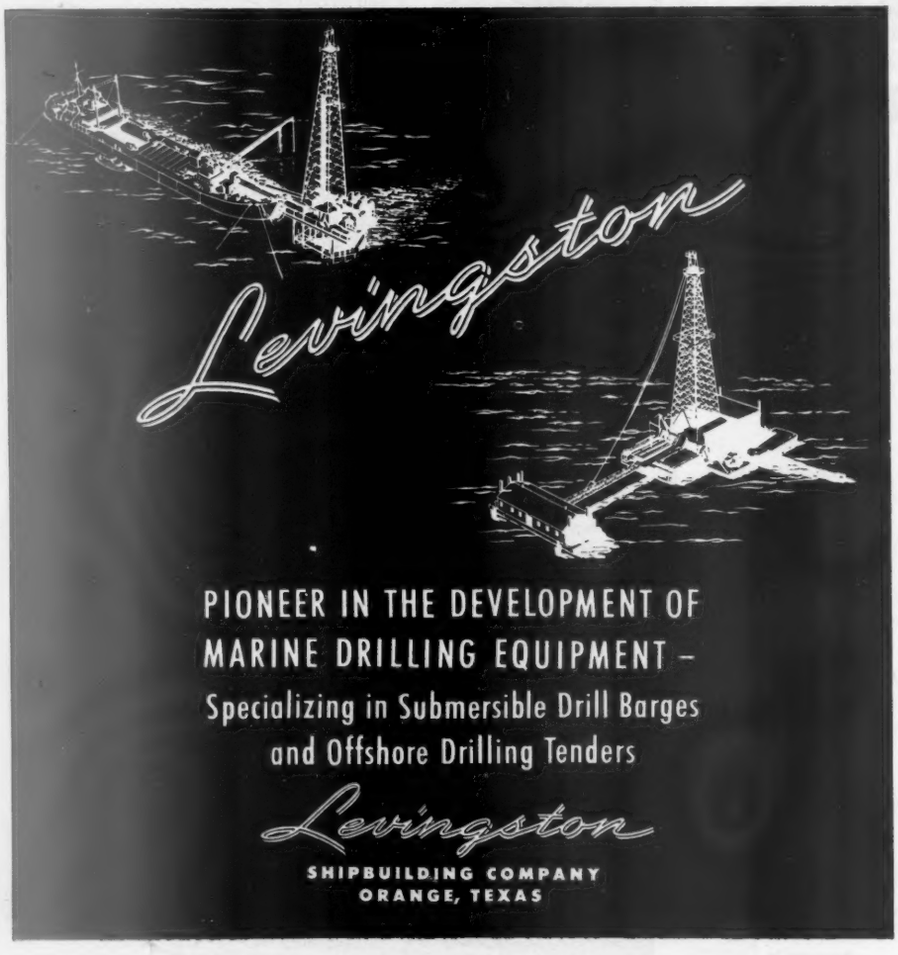
New Sales Manager

Tracy T. Word, Jr., has been appointed sales manager of Well Equipment Manufacturing Corporation. As well as being in charge of the sales



Tracy T. Word, Jr.

and service activities of the WECO organization he will supervise the training program, under which new men are being continually prepared for field service. Word replaces G. R. Winder, who has been appointed vice president and sales manager of Chiksan Company, parent organization of WECO.



Named Chief Engineer

C. W. Dawson has been appointed chief engineer of the producing department of Standard Oil Company of California. The position was made

vacant by the recent death of H. B. Davis. Dawson has been with Standard since June, 1929, after being graduated from Stanford University with an A.B. degree in mechanical engineering.

Announced at the same time were the appointments of V. L. Taylor as field superintendent, Coalinga Area, producing department, and R. W. Norton as assistant to the general manager (operations), producing department, San Francisco office. Norton succeeds Taylor in the latter position. Both men began their service with Standard in 1935.

Hydrafrac Licensed

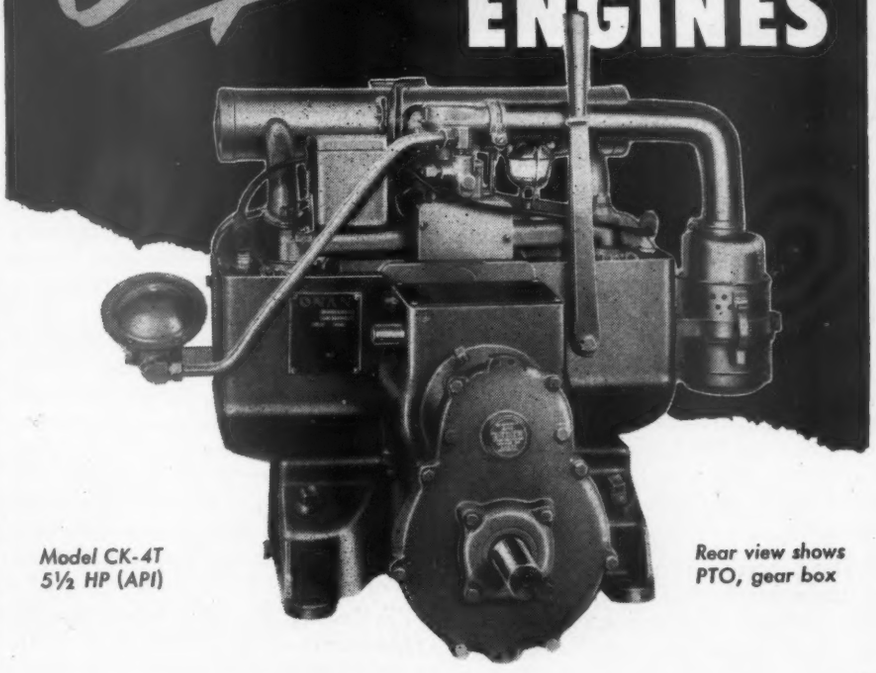
Stanolind Oil and Gas Company has licensed the Halliburton Oil Well Cementing Company of Duncan, Oklahoma, to service wells with the hydrafrac process.

The process, developed at the Stanolind research laboratories uses a viscous liquid, such as jellied gasoline or jellied light crude oil to fracture underground formations by hydraulic pressure. This liquid is pumped into the well under very high pressure; it splits the oil-bearing formations and opens cracks through which the oil can flow to the well-holes. Sand may be suspended in the fluid to help keep the cracks from closing by acting as a prop within the fracture.

After the rocks have been split, a liquid chemical may be pumped into the well to break the fracturing fluid into a thin liquid, thus allowing it to flow out of the well with the oil being produced.

The Halliburton Company has been given an exclusive license for at least two years. In addition, Halliburton has the right to license operators in certain foreign countries to use the process on a commercial basis.

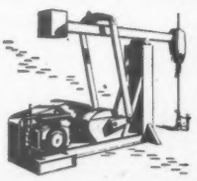
ONAN "CK" Oilfielder ENGINES



Model CK-4T
5½ HP (API)

Rear view shows PTO, gear box

Built for Continuous Duty on Tough Pumping Jobs!



Do you have a job for a 5½ HP roughneck? Here's a dependable 1000-inch-pound torque engine that will do a job for you day-in and day-out with minimum maintenance and attention. No cooling problem because it's air-cooled. Little or no sludging. Has features of an engine many times its size. Smoother-running because of its twin-cylinder, horizontally-opposed design, the Onan "CK" Oilfielder gives lasting service on the toughest jobs.

Full pressure lubrication by gear-type oil pump. Runs on either gas or gasoline. Check with your supply house or write.

ONAN OILFIELDER ENGINE—5½ HP.
ONAN ELECTRIC PLANTS—A.C.: 350 to 35,000 watts. D.C.: 750 to 15,000 watts. Gas-gasoline and Diesel models.

D. W. ONAN & SONS INC.
5362 Royalston Ave. Minneapolis 5, Minn.

• 1000-inch-pound torque • 5½ HP continuous duty (by API formula) • 960-ft. piston speed • 525 PTO shaft speed through 4.1 gear reduction • Over-center dry disc clutch • 4-quart oil sump • Air-cooled by large axial-flow blower.

Onan PRODUCTS ENGINES & ELECTRIC PLANTS

UNDERGROUND DAM CONTROLS SUBSURFACE WATER SEEPAGE

Subsurface seepage, one of the chief causes of loss or pollution of water, may now be controlled by constructing a permanent underground dam by means of an asphalt emulsion, it was announced by Shell Oil Company. The subterranean barrier is built without excavating, by injecting the asphalt emulsion into the earth through a pipe. Already used to check serious loss of irrigation water through an earth dam on the Santa Ana River in California, the new method is marketed under the trade name of Shellperm.

The process represents a landmark in the control of subsurface flow, it was declared. The underground barrier may prevent serious leakage of water through banks or reservoirs, check contamination caused by infiltration, and prevent sea water from seeping into fresh water wells. Aside from its role in water conservation, Shellperm can also be used to check seepage around tunnels, road beds, or other subsurface structures, without the use of such relatively expensive techniques as sheet piling. The new process is especially significant, according to a Shell spokesman, because heretofore control of underground movement of water has been costly and difficult at depths of more than a few feet.

The Shellperm process employs an emulsion of asphalt in water, which is pumped under low pressure through a metal pipe driven into the ground. Emerging from the pipe, the emulsion spreads out roughly in the form of a ball. Chemicals mixed with the emulsion then cause the asphalt to coalesce, producing a mass impermeable to water.

Following the first injection, the pipe is raised, and additional Shellperm is pumped down to form a second impermeable mass. After repeated injections have produced a vertical asphalt column, the pipe is moved and additional injections are made to create another column. The process is repeated until abutting or overlapping columns form an underground dam.

REPORT ON ELLENBURGER IN CENTRAL TEXAS AVAILABLE

John T. Lonsdale, director of the Bureau of Economic Geology, the University of Texas, has announced that Publication 4621, "The Ellenburger Group of Central Texas," by P. E. Cloud, Jr., and V. E. Barnes, is available for distribution. The geological investigation reported in this publication was made cooperatively by the Bureau of Economic Geology and the United States Geological Survey.

The publication is an exhaustive and comprehensive treatment of the Ellenburger group in central Texas with consideration also of correlation with the rocks of other regions, including the Ozark region, Arbuckle and Wichita Mountains in Oklahoma, Marathon basin, Sierra Diablo region, Hueco Mountains, Franklin Mountains, and others. In addition to the general and regional studies of the central Texas area as a whole, nine areas are described in detail with measured sections and maps. Strata immediately above and below the Ellenburger are also considered in the report. Included also are descriptions of the economic resources of the Ellenburger strata.

The publication consists of 473 pages with 8 text figures, 17 maps and sections, and 28 wholetone plates. Inquiries concerning the publication should be addressed to the Bureau of Economic Geology, The University of Texas, University Station, Box B, Austin 12, Texas.

Service Pins Presented. Recently The Continental Supply Company, Dallas, held the first in a series of Service Pin Awards dinners to honor all employes of five years or more service with the company. At the first dinner, held in the Baker Hotel, Dallas, for the Dallas-Fort Worth group, 105 employes received pins. Sixty-eight of the men and women present were recognized for service of 5 to 25 years, and 34 were presented pins with a single diamond for service of 25 to 35 years.

Two-diamond pins, signifying 35 years, were presented to two men: R. R. Lewis, manager of the sales department, and H. A. Jostrand, recently retired manager of accounts receivable. W. J. Morris, chairman of the board, was presented a three-diamond pin in recognition of his 40 years connection with the company.

Egyptian Well Overrated

Previously reported claims of the Egyptian Government for Asl 5 in the Sinai Peninsula were based on two short tests of a few minutes each, and have since proved about 10 or 12 times too high. When Socony-Vacuum Oil Company engineers finished a proper test, they announced the flow as 3400 bbl per day through open tubing, or comparable to some of the better wells in the Asl and Sudr fields.

The Asl field is located on a lease covering 24,710 acres of which 200 acres may be considered proved, based upon three producers in the field.

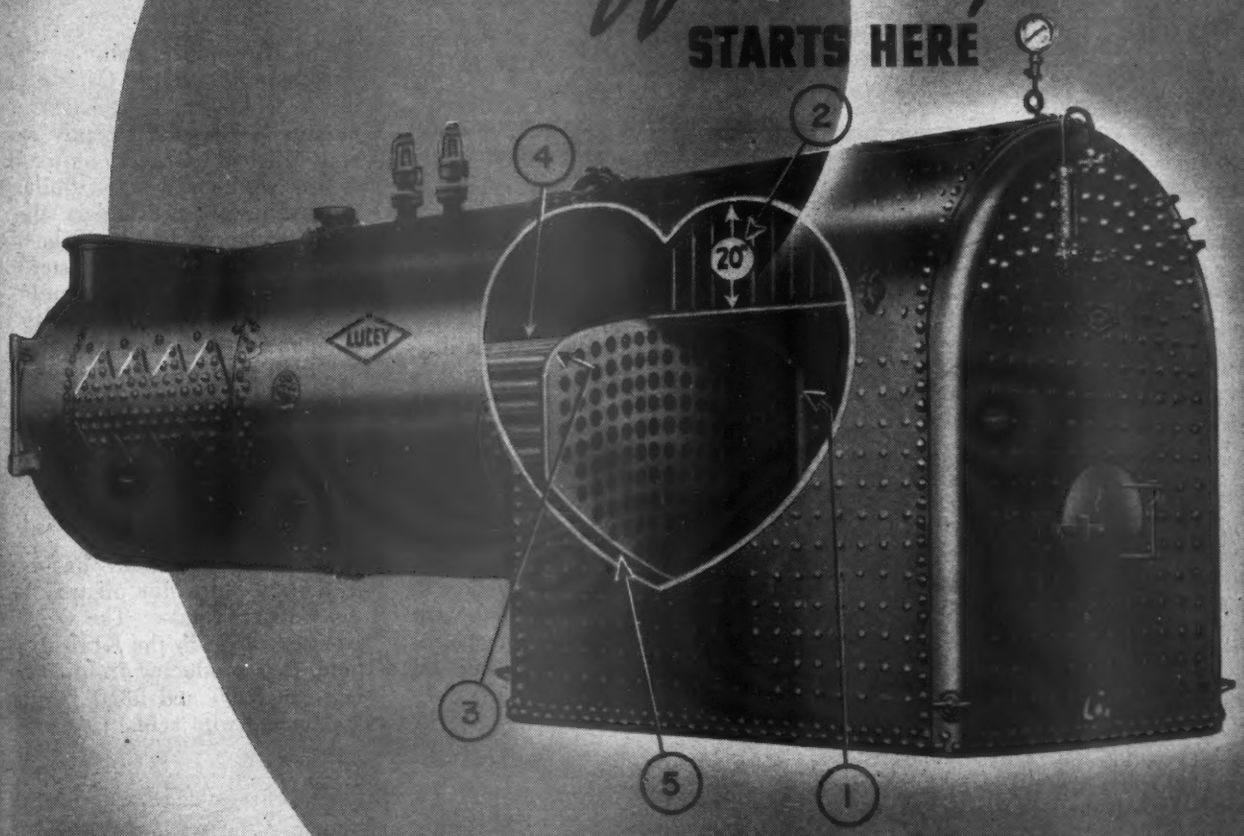
Ideco Opens New Store

T. D. Collins, vice president Ideco Mid-Continent direct sales, has announced the opening of a new oil field supply store located at Hays, Kansas. E. E. Keating has been appointed store manager. This new installation will be operated under the direction of the Kansas district manager, R. R. "Lefty" Matthews.

LUCEY BOILER

Efficiency

STARTS HERE



1. **All-welded fire box**
2. **20" steam liberating space**
3. **Arched crown sheet, large corner radii**
4. **Short seamless tubes in vertical rows**
5. **4" water space all around fire box**

In the oil country, you can do a better, safer job with a LUCEY. This HIGH-TENSILE STRENGTH boiler is the lightest weight boiler per horse power on the market. 150 H.P. 350# W.P.

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What's Doing in DRILLING

Rig Operations Down

There were nearly 14 per cent less rotary rigs operating at the end of January than a month earlier. This decline of 306 (from 2247 to 1941) is considered more than seasonal by certain industry spokesmen. High stocks of crude and the resultant downward pressure on prices are considered the chief contributing factors in the curtailment of operations. Rigs running at the end of January were as follows:

Pacific Coast	191
Kansas	103
Oklahoma	211
Rocky Mountains and Western Canada	168
North Louisiana-East Texas-Arkansas	166
West Texas-New Mexico-North Texas	449
Illinois-Indiana-Kentucky	61
Gulf Coast	592
Total	1941

Management Institutes

In full swing is the series of management institutes sponsored by the American Association of Oilwell Drilling Contractors and jointly conducted by the University of Texas and the Agricultural and Mechanical College of Oklahoma. Six conferences comprise the series that are being presented in 15 U. S. major oil centers.

Florida Test

Coastal Petroleum Company, an affiliate of Pan-Coastal Oil Company, C. A., has started drilling a well (the No. 1 Ronald Sap) in Lafayette County, Florida, according to B. W. Heath, vice president of Coastal. The operators plan to test for oil at a depth of about 2900 ft.

Observes Tests of New Rig

Edgar "E. C." Johnston, prominent Texas oil producer, contractor, and partner in the Johnston Enterprises, Longview, Texas, has made a trip to Hydra-Line's California establishment at Los Angeles to watch shop and field testing of the Hydra-Line MD-975. Accompanying him were his financial manager, Link Martin, his drilling superintendent, Ray Bedingfield, and his son, Glenn Johnston, who is one of the owners of Johnston Enterprises.

E. C. Johnston

A. F. Barrett is the new manager of Rocky Mountain operations for General Petroleum Corporation at Casper, Wyoming. *(See The Petroleum Engineer for February.)*

New Depth Record

Superior Oil Company of California states it has broken its own world's depth record with No. 1 Limoneira, section 9-2n-22w, Ventura county, California. The well was making hole at a rate of 70-80 ft a day and had reached 17,926 ft in mid-February. Latest depth reported was 18,500 ft.

Previous depth record was held by the company's No. 51-11 Weller in Caddo county, Oklahoma, which went to 17,823 ft. Robert Fowler, petroleum engineer for Superior, said oil showings have been found in the California well.

English-Built Drills

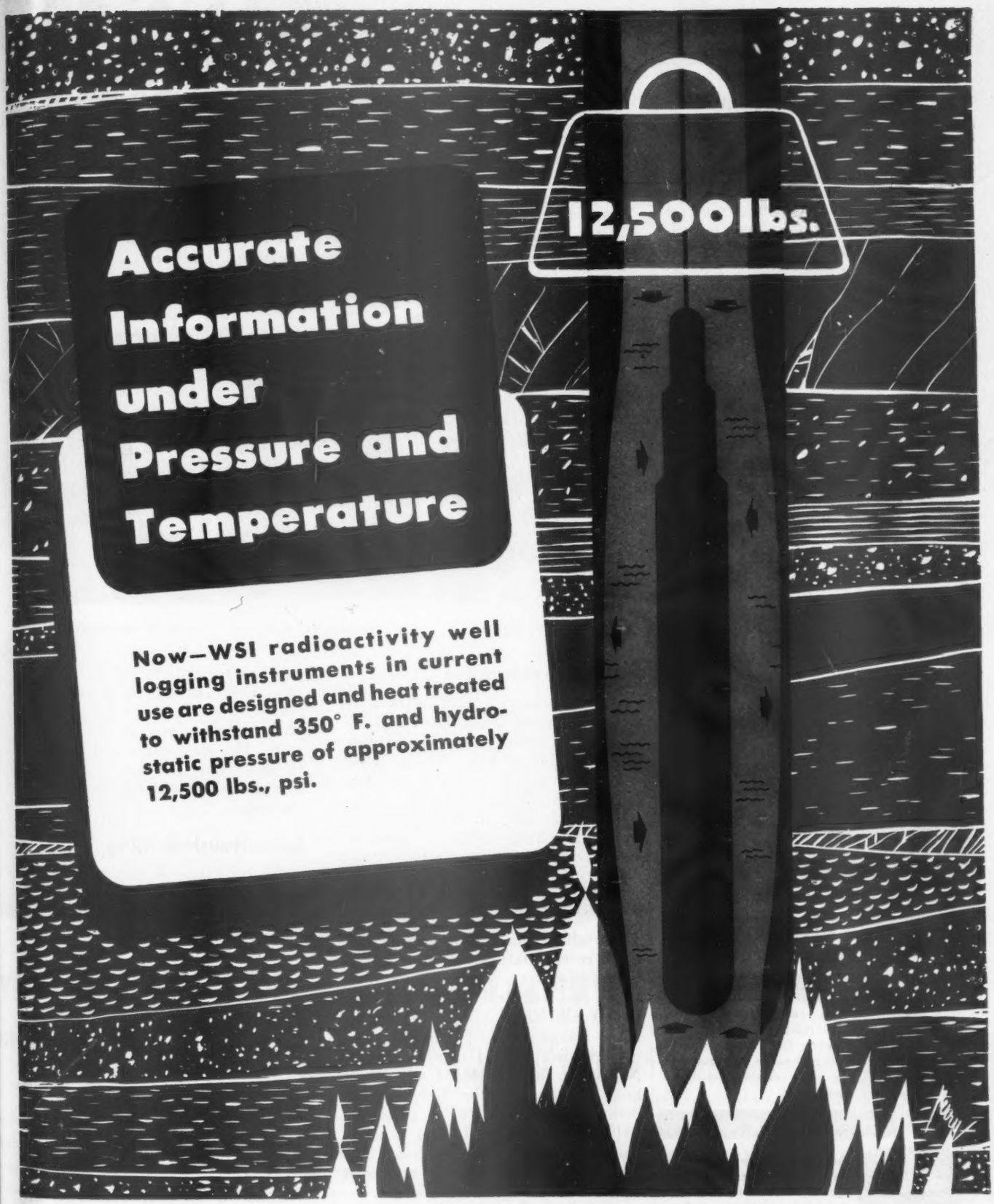
A new technique, designed to reach areas that otherwise might not be served due to the dollar shortage, has just been announced by the George E. Failing Supply Company of Enid, Oklahoma, manufacturers of portable drilling and exploration equipment. The company has licensed the Mitchell Engineering Company, Ltd. of England to manufacture the Failing line in its plant at Peterborough.

E. L. Alexander, Failing's chief engineer, and Everett P. Carley, Failing design engineer, have spent several months in England recently working with Mitchell engineers on the design of the equipment to be built there. According to Alexander, the first model to be produced will be similar to the Failing 1500 Holemaster model, except that all parts have been changed to incorporate British made components and standards. The English-built drill will have a capacity of 2500 ft with 2⅜-in. drill pipe, 1650 ft with 2⅞-in. drill pipe, and 1000 ft with 3½-in. drill pipe.

New Kansas Well

Skelly Oil Company has brought in a 1922 bbl a day oil well in Barton County, Kansas. The well, No. 7 Grosshardt, is in the Kraft-Prusa oil field. It is producing from a depth of between 3295 and 3310 ft after being treated with acid.

Among persons taking part in the commissioning of a drilling barge for the Gulf Coast Drilling company at the Bethlehem shipyards in Beaumont, Texas, were: L. A. Sunkel, manager of domestic production, Atlantic Refining Company, Dallas; J. R. Davidson, drilling superintendent, Atlantic, Dallas; John Marston, operations manager, Atlantic, Dallas; R. H. Reeves, co-owner of Gulf Coast Drilling Company, New Orleans; Mrs. Reeves; J. J. Rebstock, co-owner of Gulf Coast Drilling, New Orleans; Mrs. Rebstock; E. C. Rechtin, general manager of the Bethlehem yards; D. D. Strohmeier, vice president, shipbuilding division, Bethlehem Steel Company, New York, and C. R. Zimmerman, vice president, Bethlehem Supply Company, Tulsa.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DRILLING

Critical Drilling Material

About nine years ago the oil industry discovered that quebracho, a South American hardwood high in tannin content that had long been used in the leather industry, could be used to control the viscosity of drilling muds. Promptly, demand went up sharply and the price doubled to 20 cents a pound. In recent years the United States has been importing 100,000 tons a year, or a $400,000,000 business. Oil well drillers are taking about 40 per cent of this supply.

Recently the munitions board placed quebracho on the critical list, pointing out that there is no stockpile. The board asked the drilling industry to look for substitutes and a committee headed by John R. Suman, Standard Oil Company (New Jersey), has been named by the National Petroleum Council to look into the matter. According to the interior department the most likely substitutes known are the bark of the California redwood, now entirely wasted, and the lignosulphates, waste products from the pulp paper industry.

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Work 40 Months Without Accident

Some 400 safety-minded workmen of Wilson-Snyder Manufacturing Division of Oil Well Supply Company who have been on the job for more than 40 months, a total of 2¼ million man hours without a single lost time accident, have been presented a first place safety award of the National Safety Council, for one of the safest work records ever made by a heavy industrial plant in the United States.

Since June 15, 1945, no employe has been off work due to an accident at this U. S. Steel plant in Braddock, Pennsylvania. "Oilwell's" national headquarters is at Dallas.

Wilson-Snyder produces oil country equipment, such as pumps for drilling wells and for driving oil through pipe lines. Its work covers precision machining of big steel pieces, high pressure testing, and assembling of heavy duty pumps and pumping machinery. Some of the pieces handled by the workmen weigh up to 50,000 lb.

W. A. Scott | Furniss M. Prell | W. H. Westergard

New Representative

W. A. "Scotty" Scott of Houston has been named Texas Gulf Coast representative for American Manufacturing Company of Fort Worth, Texas. Scott, who has his office in the West Building in Houston, has been associated with the oil field equipment and supply business for 35 years, the past 16 in Texas and the Gulf Coast area.

Portable Offsets Discovery

Portable Drilling Company has offset a recent Okfuskee County, Oklahoma, discovery with two new locations, and will drill the No. 2 Harge in NW SW NE of 31-13n-10e and the No. 3 Harge in SE SE NE of 31.

Portable's No. 1 Harge in NW SE NE of 31 flowed 44 bbl of oil per hour with gas at the daily rate of 3000 MCF from 2885-95 ft in the Gilcrease-Dutcher. It was pinched back to about 15 bbl per hour. The new pool is about ¾ mile southwest of the South Haydenville field.

Prell Joins A-1

Furniss M. Prell, formerly of the Hughes Tool Company, has accepted the position of Central Louisiana division sales manager with the A-1 Bit and Tool Company. His headquarters will be in Lafayette, Louisiana.

Prell entered the oil game 30 years ago, first working for the Texas Company as roughneck and driller, then two years with Trinidad Leaseholds, following which he spent 8 years with Shell Oil Company as drilling foreman. He was connected with the Hughes Tool Company for 13 years in various capacities in the sales department.

Joins Housh Drilling

W. H. (Tex) Westergard, former manager of sales for the Edwards Wire Rope Company, has recently become associated with Housh Drilling Company, Houston.

Westergard was associated with the Edwards Wire Rope Company for 14 years. He formerly was manager of the Houston branch and was transfered to the San Francisco offices of the company 6 years ago where he held the position of manager of sales for Edwards.

Deeper Pay Opened At Cuyama

Richfield Oil Corporation recently placed on production its Anderson 18-30 well in the Cuyama Valley from a deep zone discovered about 500 ft below the Diblee zone from which the field had been producing. The well came in flowing at a rate of 1320 bbl of oil per day through ½-in. bean, 37.8 gravity. The new zone is approximately 150 ft in thickness. Total depth of the well is 3642 ft.

Wilson

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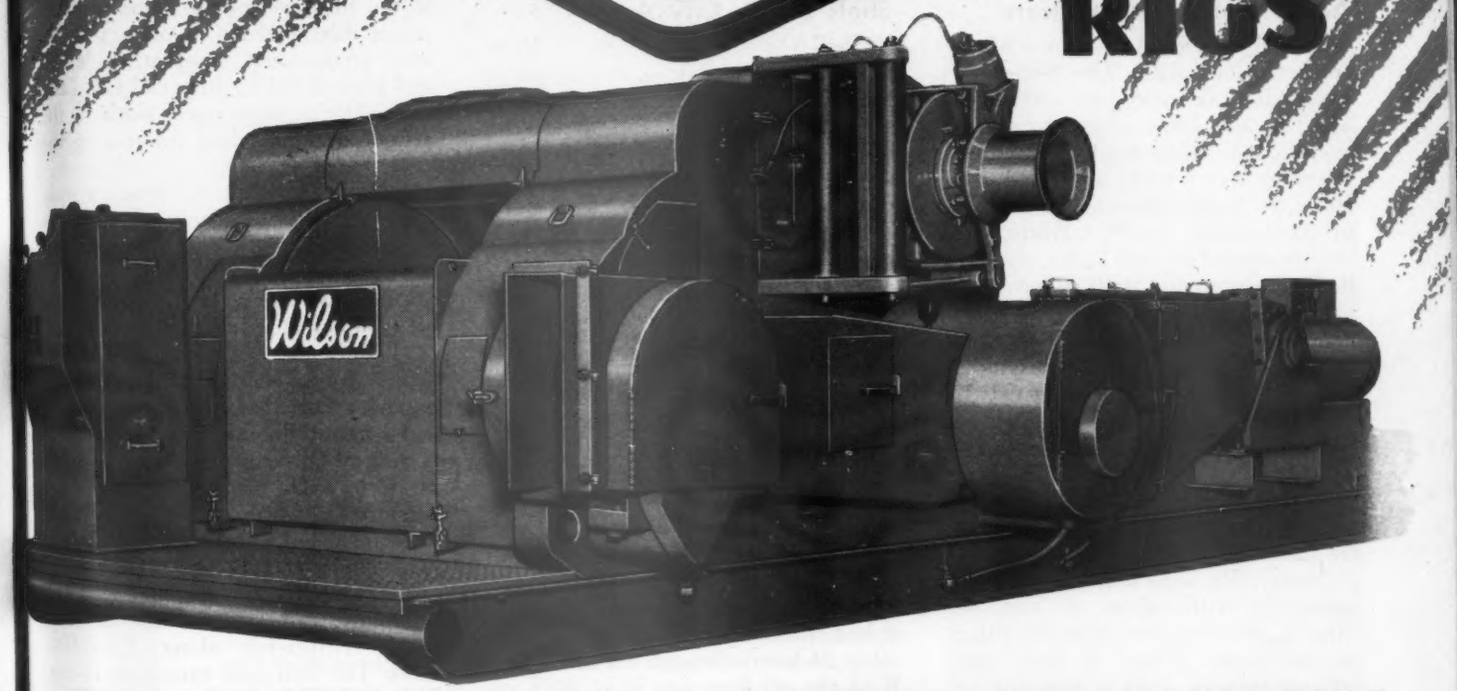

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EXPLORATION ACTIVITIES

C. W. Tomlinson
President

Theodore A. Link
Vice President

Henry N. Toler
Secretary-Treasurer

Alfred H. Bell
Editor

AAPG Elects New Officers

The American Association of Petroleum Geologists, The Society of Economic Paleontologists and Mineralogists, and The Society of Explroation Geophysicists held their annual meetings March 14-17 at the Jefferson Hotel, St. Louis, Missouri. At the close of the meeting AAPG officers, previously elected by mail ballot, assumed their duties for the 1949-50 term.

C. W. Tomlinson, the new president, is an Ardmore, Oklahoma, independent geologist and oil producer, who has had a wide range of experience and is a recognized authority on Oklahoma structural geology and stratigraphy.

Theodore A. Link, vice president, was the chief geologist for Imperial Oil Limited at the time of the Leduc discovery. He is now an independent consultant with offices in Toronto, Ontario, and Calgary, Alberta. Other officers include Henry N. Toler, secretary-treasurer, who is manager of the geological and land department, Southern Natural Gas Company, Jackson, Mississippi, and Editor Alfred H. Bell, head of the Oil and Gas Division, Illinois State Geological Survey, at Urbana.

Humble Finds Two Pools

Humble Oil and Refining Company has added two pools to the discovery list of Scurry County, Texas. No. 1 Bishop, 164-97-H&TC, a mile northwest of the Sharon Ridge field, flowed 19 bbl per hr through 3/8-in. choke for 12 hours. Gas oil ratio was 880 to 1. Production is from perforations at 6650-79 ft in the Canyon lime.

The company's No. 1 Periman, wildcat in 438-97-H&TC about 1½ miles north and slightly west of the North Snyder field, flowed from 7050-70 ft in the lower Canyon.

Shell in Elk City Area

Shell Oil Company's No. 1 Kelly CNE SW 23-10-21w, a mile south of the discovery well, has become the second oil producer and the fourth productive well in the Elk City area of Beckham County, Oklahoma. As did the first oil producer, Shell's No. 1 Long, a mile west of the field discovery, the Kelly found two oil zones and two distillate zones. The Kelly, plugged back to 10,250 ft from an original depth of 10,600 ft, was perforated at 10,130-180 ft and the deepest productive zone tested. Oil flowed at 21 bbl per hour through 5/8-in. choke with a gas oil ratio of 1580 to 1.

The No. 1 Long, on which a drill stem test was reported in the January issue of *The Petroleum Engineer*, was plugged back to produce from the upper pay horizon known as the "9100-ft oil zone." In early February it had made 2345 bbl of 49 gravity oil in 24 hours through a 1-in. choke. With the oil flow was 3654 MCF of gas. Shell has two other wells drilling in the area.

Library Donated

The library of the late Dr. Gayle Scott, eminent Texas geologist, well-known in both the oil industry and in scientific circles throughout the world, has been donated to Texas Christian University by Dr. Scott's widow, Mrs. Mary Beth Scott, it was announced today by Dr. M. E. Sadler, TCU president.

One of the most complete libraries on Texas geology in existence, and consequently of unique importance to oil industry geologists, the complete collection will be available to outside scientists and industrial personnel as well as to TCU students and faculty members, Mrs. Scott and Dr. Sadler announced jointly.

Oil Activities Accelerated Around Edmonton

Already much publicized because of the Leduc and Woodbend fields 20 miles to the south and southwest and the Redwater field 30 miles to the northeast, Edmonton in Alberta, Canada, now has discoveries 60 miles to the northwest and 25 miles to the southeast. With an extension to the Redwater field and a discovery a few miles northwest of the Woodbend field the boom continues.

Stanolind Gas and Oil Company, Ltd., subsidiary of Standard Oil Company (Indiana), made the discovery to the northwest with Stanolind Imperial Barrhead No. 1 on a 160,000 acre government reservation leased and farmed out by Imperial Oil, Ltd., who did the geophysical work in the area and retains half interest in the well.

Imperial's No. 1 Schoepp, a mile north and 4½ miles west of the Woodbend field, found 38 gravity oil after being drilled to 5380 ft. This well may open a new field, as is possible for the oil producing wildcat 22 miles east of Leduc, the No. 1 Joseph Lake, owned by General Petroleum, Ltd., Superior Oils, Ltd., Kroy Oils, Ltd., and Jupiter Oils, Ltd.

Sunray Oil Company, a subsidiary of Sunray Oil Corporation, Pacific Western Oil Corporation, Tide Water Associated Oil Company, and Pacific Petroleums, Ltd., a Canadian corporation, recently formed the Bear Oil Company, Ltd., to test and develop tracts comprising about 4,600,000 acres. The half-mile extension to the Redwater field with Sunray-Pacific—Redwater No. 1 is their first success, and preparation is underway to drill No. 2 and 3 east and southeast of the discovery. Possible natural gas production has been indicated by Sunray-Pacific No. 1 at Halfway Lake, northwest of the Redwater lease.

New Texas Field

The Texas Company has announced the discovery of a new oil field with the completion of the Newton County Lumber Company Number 1, about 8 miles southeast of Call, Texas. On an initial test the well flowed at the rate of 60 bbl daily on ¼-in. choke.

Drilled to a total depth of 12,610 ft, the well was plugged back and completed through perforations from 9644-9660 ft in the Wilcox. Tubing pressure was 240 psi, the gas-oil ratio, 1600-1, and the corrected gravity 44.

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Two Gulf Coast Fields

A new high gravity oil field has been discovered in Galveston Bay and another new field is indicated south of the Oyster Bayou field in Chambers County by tests on two Sun Oil Company wells. The company's No. 1 State Hannah on lease 232 in the Hannah Reef area, Galveston County, gauged 135 bbl of 50.2 gravity crude through 10/64-in. choke on a 24-hr test. Production was from casing perforations between 10,674 and 10,688 ft. Sun's No. 30 Felix Jackson well, 1½ miles south of the Oyster Bayou field, flowed an unestimated amount of oil cut with considerable amount of water while cleaning in preparation at 9543 to 9544 ft. The test is on a 10,142 acre tract. The well is producing from the lower Frio formation.

Lane-Wells Adds Hoist Units. During 1948, a total of 31 new hoist trucks and 7 skid units were added to the Lane-Wells service fleet. The company states that these units contain the latest technical equipment required for modern perforating, radioactivity well logging, and electrolog service. One of the trucks is shown above.

Poulter Seismic Method Demonstrated for Pemex

The first international tests of the new Poulter seismic exploration method, conducted in Mexico, at the request of Petroleos Mexicanos, have been pronounced successful by the Institute of Inventive Research, sponsor of the method's development. Crews of Geophysical Service, Inc., Dallas, made the tests south of Reynosa, in the State of Tamaulipas, before representatives from Pemex, Westby Geophysical Company of Tulsa, the Institute of Inventive Research, and officials of the company conducting the demonstration.

(For a description of the method refer to *The Petroleum Engineer*, December, 1948, "Above Ground Detonations Used in Seismic Exploration," page 124.)

Bailey Willis Dies

Bailey Willis, internationally known seismologist and geologist, died at a Palo Alto, California hospital. February 19 after a short illness. He was 91 years old.

Popularly known as the man who predicted the great Santa Barbara earthquake of 1925, Dr. Willis in 1915 accepted an invitation to head the department of geology at Stanford University. It was there he began to develop his special interest in seismology. From 1921 to 1926 he was president of the Seismological Society of America.

Barnsdall Opens First Mississippi Field of '49

Barnsdall Oil Company gave Mississippi its first oil field of the year upon completing the rank wildcat No. 1 J. A. Pittman in Franklin County for a 356 bbl daily flow of 43.8 gravity oil. The company staked No. 2 Pittman and has been followed by three other operators who have staked five more locations in the area, known as the Bude Field.

The discovery opened the fourth producing area in Franklin County.

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F. R. Yost

▸ **F. R. Yost** has been named to the newly-created post of manager of the producing department of Stanolind Oil and Gas Company. He thus assumes responsibility for Stanolind's producing operations in 11 states from Montana to Mississippi. Last year crude oil production averaged more than 200,000 bbl a day.

The new department manager started in the oil business as a roughneck with the Yount-Lee Oil Company in 1934. The following year, when most of the Yount-Lee properties were purchased by Stanolind, he went on the Stanolind payroll as a roughneck in the High Island field in Texas.

After that, Yost worked as driller, tool pusher and field superintendent. In 1943, he was named head of industrial relations for the Texas-Louisiana Gulf Coast division in Houston. Later he became district production superintendent for Kansas. In 1945 Yost was made drilling superintendent in the producing department. Since January 1, 1947, he has been operating superintendent.

He attended the University of Texas, and recently took the advanced management course of the Harvard Graduate School of Business Administration.

▸ **Frank Lindeman, Jr.,** has been made operating superintendent of the producing department of Stanolind Oil and Gas Company, succeeding F. R. Yost. Lindeman has been assistant division production superintendent for the Texas-Louisiana Gulf Coast division at Houston, Texas, in charge of Stanolind's offshore operations in the Gulf of Mexico since last August. He has been with the company since 1933.

▸ **S. T. Yuster** of The Pennsylvania State College will act as advisor on the production research program of the Pennsylvania Grade Crude Oil Association, it was announced following a meeting of the Association production research committee. Dr. Yuster will serve in an advisory capacity pending completion of plans for direction of the research program, supervised until recently by Dr. Richard V. Hughes who resigned to join the faculty of Stanford University.

▸ **Ralph C. Farley,** of The Ohio Oil Company has been appointed assistant to the general superintendent of production, Fred E. Smith. Farley, who has been district superintendent in direct charge of the company's offshore operations in the Gulf of Mexico, assumed his new duties in the general offices in Findlay, Ohio, February 1. He began his career with the

Ralph C. Farley

John S. Leonard

Ohio in the pipe line department at Del Rio, Texas, in 1926.

John S. Leonard, drilling foreman at Reed City, Michigan, succeeded Farley as superintendent of operations in the Gulf.

H. R. Bolton, division petroleum engineer at Tulsa, has been transferred to Marshall, Illinois, as division petroleum engineer for the company's Terre Haute, Indiana, division.

R. E. McMillen, district petroleum engineer at Midland, Texas, has been appointed to succeed Bolton as division engineer at Tulsa. **D. V. Kitley,** petroleum engineer in the Midland district, has been assigned as district engineer for the Midland district.

▸ **F. S. (Bud) Fobes** has been appointed assistant sales manager, Western Division, Baker Oil Tools, Inc.

F. S. Fobes

F. A. Thorne

He has been associated with the company since 1940, with time out for four years with the U. S. Navy. Succeeding Fobes as director of advertising and publicity is **Frank A. Thorne,** who has been connected with Baker Oil Tools, Inc., since November, 1947.

▸ **Elmer R. Tieberman,** Lukenheimer Company representative, who for many years handled the oil field sales territory embracing Oklahoma and Kansas, with headquarters in Tulsa, has transferred to Dallas, Texas, covering north-eastern Texas, northern Louisiana, and part of Arkansas. **Duffie "Dave" Davis** succeeds Tieberman at Tulsa. Davis formerly worked out of Wichita Falls, covering west Texas. **William A. Boles,** Wichita Falls, recently joined the company and will take over the territory formerly handled by Davis.

▸ **Joseph Saxon, Jr.,** of Wyandotte, Michigan, has joined the staff of the Pennsylvania Grade Crude Oil Association's secondary recovery research laboratory at Bradford. Saxon has been a production engineer in the research department of Wyandotte Chemicals Corporation, supervising the semi-commercial pilot plant production of aromatic sulphonic acid derivatives.

▸ **S. M. Miller** has been named manager of the Pampa, Texas store of Oil Well Supply Company, U. S. Steel subsidiary, and **C. V. Black** has succeeded him as manager of the store at Abilene, Texas.

Miller has been manager of the Abilene store since 1947. Prior to that time, he was connected with "Oilwell" stores at Albany, Talco, and Greggton.

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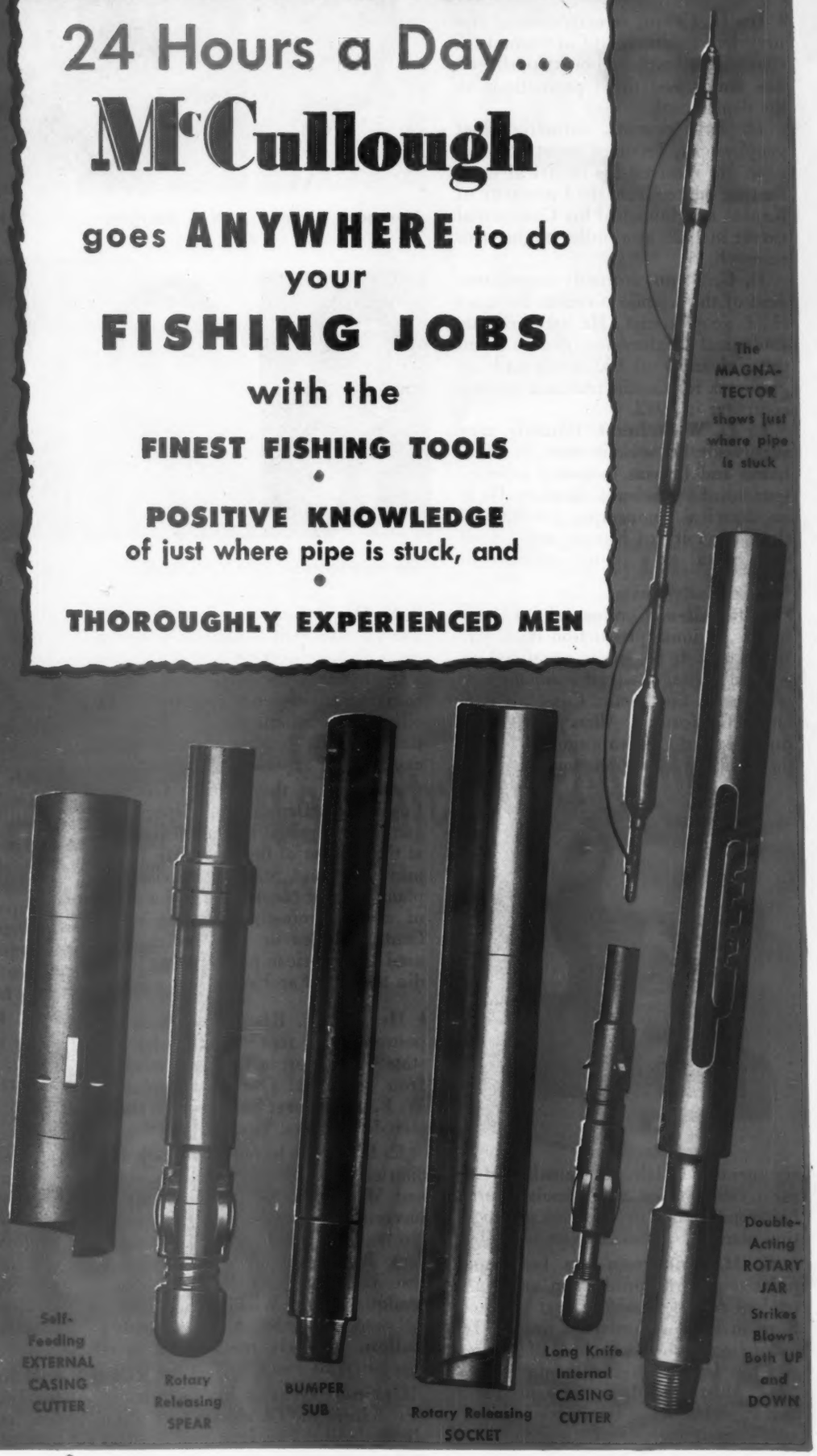
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Double-Acting ROTARY JAR Strikes Blows Both UP and DOWN

PERSONALS

Ira H. Cram, recently-elected vice president in charge of Continental Oil Company's exploration department, has announced three promotions in the department.

H. R. Prescott, formerly chief geophysicist, becomes assistant manager. He received his electrical engineering degree from the University of Kansas and launched his Continental career in 1928 as a junior engineer in research.

B. G. Swan, formerly superintendent of the seismic division, becomes chief geophysicist. He received his geological engineering degree from the University of Oklahoma and began work for Continental as a seismos computer in 1932.

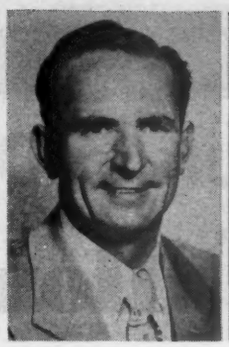
L. E. Whitehead, formerly area supervisor for seismic work in Oklahoma and Kansas, becomes superintendent of the seismic division. He is an electrical engineering graduate of the University of Kansas and joined Continental as a junior engineer in 1927.

C. R. Allen, Continental Oil Company's regional production manager, Los Angeles, has been promoted to general manager of all company operations in the Pacific Coast area. A native Californian, Allen joined Continental nearly 25 years ago. He served the company in various important as-

C. R. Allen

signments in Oklahoma, Canada, Colorado, New Mexico, and Illinois before being promoted to regional production manager at Los Angeles in 1946.

B. H. Anderson has been appointed general production superintendent for the Pacific Coast region. Born in Denver, Anderson was graduated from Colorado School of Mines and has been with Continental since 1934. Most recently he was production superintendent for South Louisiana, located at Basile, Louisiana.



Herbert C. Risner

W. F. Behrhorst

E. H. Royle

A. G. Pullen

Herman Lawson

P. L. Gillis

O. W. Frogge

Walt McCharen

E. H. Staber, manager of Standard-Vacuum Oil Company's operations and engineering department and a key figure in the development of the company's petroleum distribution facilities throughout the Far East, retired January 1, after 35 years of oil engineering experience.

As head of the wartime Overseas Engineering Department, a special organization created by the oil industry at the request of the U. S. Air Transport Command, Staber supervised the planning and construction of a chain of aircraft refueling stations across Central Africa in 1942 which were used by American planes flying to India and the Far East.

Herbert C. Risner has been appointed sales representative for the state of California for the American Iron and Steel Company, replacing **W. F. Behrhorst** who has been transferred to Odessa, Texas.

E. H. Royle has been promoted to district manager for South Louisiana and Mississippi for the company to succeed Austin Brashears, who was recently killed in an automobile accident. Royle was formerly sales representative in North Texas with headquarters in Wichita Falls. He is followed there by **A. G. (Andy) Pullen,** formerly rental yard manager at Oklahoma City.

Herman Lawson has been transferred from the Oklahoma City main plant of American Iron and Steel as sales representative for East Texas and North Louisiana. He will make his headquarters in Longview, Texas.

P. L. Gillis has recently joined the sales department of the company and will make his headquarters in Houma, Louisiana.

O. W. Frogge, a former driller for various contractors, is another recent addition to the sales force. He will work as representative out of the Houston district office.

Walt McCharen, formerly in the company's engineering department and chief inspector at the main plant, has joined the sales department and will make his headquarters at Hobbs, New Mexico.

B. E. Sharp, a new salesman, will work out of the Oklahoma City sales office, covering the northern part of the state.

H. O. Woodruff has been appointed assistant division manager, producing department, Pacific Coast Division of The Texas Company. He is a native Californian and a 1933 graduate of the University of Southern California in petroleum engineering. Shortly thereafter he entered the service of The Texas Company as a roustabout in the Ventura District.

Mike Moore, formerly salesman for Thornhill-Craver Company, Houston, has been promoted to sales manager of the company.

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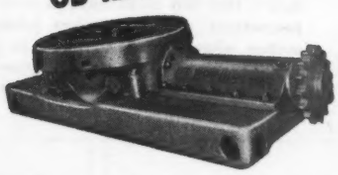
OB-12-L ROTARY



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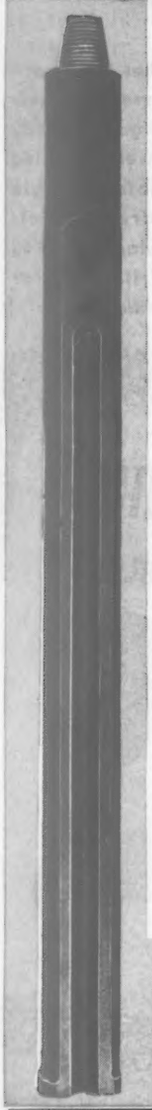

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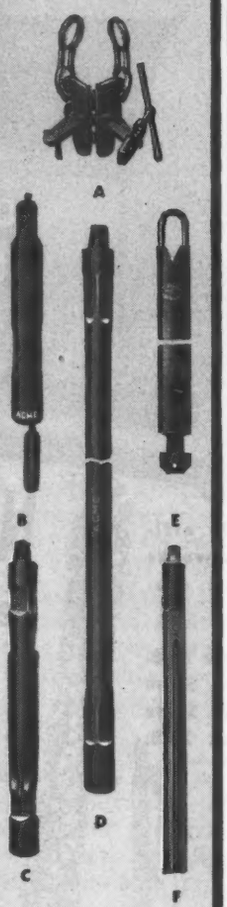

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▸ **Officers for AIME.** North Texas section 1949 officers are: Chairman, Don L. Harlan, division petroleum engineer, The Texas Company, Fort Worth; vice chairman, Jack A. Crichton, DeGolyer and MacNaughton, Dallas; vice chairman, I. E. Curtis, chairman of Operating Committee for Hull Silk Pool, Wichita Falls; secretary and treasurer, Fort Worth, S. V. McCollum, Continental Oil Company, Fort Worth; vice chairman, J. A. Slicker, Stanolind Oil and Gas Company, Fort Worth.

▸ **Horace P. Norman** is the new head of Continental Supply Company's personnel department in Dallas. All functions of a personnel nature in connection with the general offices in Dallas are under his supervision. For the immediate future Norman's activities will be confined to the Dallas offices; however, later, he will extend his work into the field.

H. P. Norman

▸ **V. L. Garlington** has replaced **F. S. Godbold** as Humble's district civil engineer in charge of construction of additions to the Conroe gasoline plant. Godbold was transferred to the Opelousas gas plant construction district to supervise construction of the new Opelousas plant. Other transfers announced by the company follow:

B. J. Smith, senior petroleum engineer, has been transferred from the Louisiana division office to the Mallalieu, Mississippi, district.

S. T. Collins, district civil engineer, has been transferred from Paradis district to Hub district, Louisiana division.

A. B. Simons, civil engineer in the Gulf Coast division, was transferred to the civil engineering department in Houston with the same title.

FLEXIBILITY *plus!*

ONLY THE O-C-T C-19 MEETS EVERY WELL COMPLETION CONDITION WITH A SINGLE COMPACT MODEL

SET IT LIKE THIS

The O-C-T "C-19" Casing Hanger is the only slip type hanger that can be wrapped around the casing and seated through the preventers to form automatically a permanent seal between strings before the preventers are unflanged.

OR SET IT LIKE THIS

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AVAILABLE IN TWO MODELS . . . WITH OR WITHOUT LOCK SCREWS.

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R. B. Paddock, service engineer of Technical Oil Tool Corporation, Ltd., left New York early in February to visit oil company offices in Europe and the oil fields of the Near, Middle, and Far East. He will inspect and test Totco equipment for controlled vertical drilling in use in the fields and advise on maintenance and replacement of equipment.

R. B. Paddock

W. S. Cook has been appointed assistant to **B. A. Hilliard,** manager of export for Byron Jackson Company. Prior to his service in the Navy during World War II, Cook attended the University of Southern California. Working in the oil fields since his discharge, he joined Byron Jackson Company in April, 1947.

Lloyd L. Bower has been apponited chief engineer of Waukesha Motor Company, succeeding **James B. Fisher,** who retired on January 31, after 35 years of active duty, according to the announcement of James E. DeLong, president. Bower has been active in the company's engineering department more than 20 years, and as Fisher's assistant for half that time.

G. H. Card C. F. Bedford

L. E. Elkins, formerly chief engineer of the producing department, has been placed in charge of Stanolind's new and expanded program of production research. **W. M. Elias,** formerly unitization superintendent, replaced Elkins as chief engineer. C. B. Caruthers, assistant unitization superintendent, moved up to superintendent.

G. H. Card, who has been North Texas-New Mexico division production superintendent at Fort Worth for Stanolind Oil and Gas Company, is being transferred to the Tulsa general office, where he will be an assistant operating superintendent in the producing department. Card joined the Midwest Refining Company in 1926 and transferred to Stanolind as a Petroleum Engineer in 1932. He held various engineering positions in Fort Worth, Tulsa, Midland, and East Texas, finally becoming division production superintendent in 1945.

C. F. Bedford has been named division production superintendent. He will come from Tulsa, where he has been chief production engineer in the producing department. Bedford first went to work for Stanolind in 1932, becoming division engineer at Houston in 1945, and development superintendent at Tulsa in June, 1947. He has been chief production engineer for the past year.

Arthur R. Brown, division engineer, is transferring to the division drilling superintendent's staff as senior mechanical engineer to be an advisor on special drilling problems.

Norman K. Andrew has been appointed assistant to **W. F. Bettis,** manager of M. O. Johnston Oil Field Service Company. Andrew has had 15 years' experience with various types of service tools in California, Texas, Louisiana, Arkansas, and Kentucky, and has been an instructor in the College of Engineering at the University of Southern California.

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THE 36-200 REGAN
Narrow-Type Traveling Block and Forged Steel Combination Casing Hook

200-TON CAPACITY

...but only 135½" from bight of hook to top of traveling block—the shortest overall working height ever offered for such capacity!

ADVANCED DESIGN

Special adapter reduces friction, allowing the forged alloy steel combination hook to smoothly swivel at the right angle to traveling block sheaves. The traveling block is compact, narrow, streamlined for maximum safety and ease of operation.

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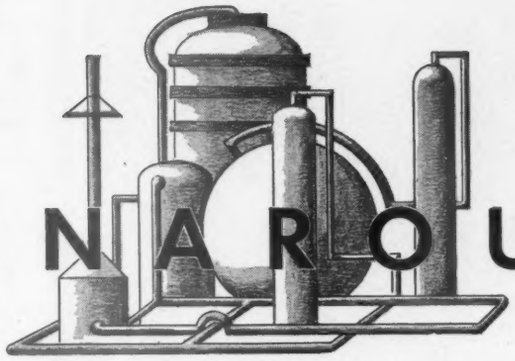
THE TURNAROUND



Watching the Molecules Pass

WHILE technological progress in the refining industry, as in any modern industrial field, is indicated generally by a fairly smooth, regular, upward-trending curve, occasionally a hump or 'peak' appears, to signalize some outstanding development or advance in the industry's know-how. Such a peak is the point of introduction of radioactive materials into the realm of research in petroleum fields.

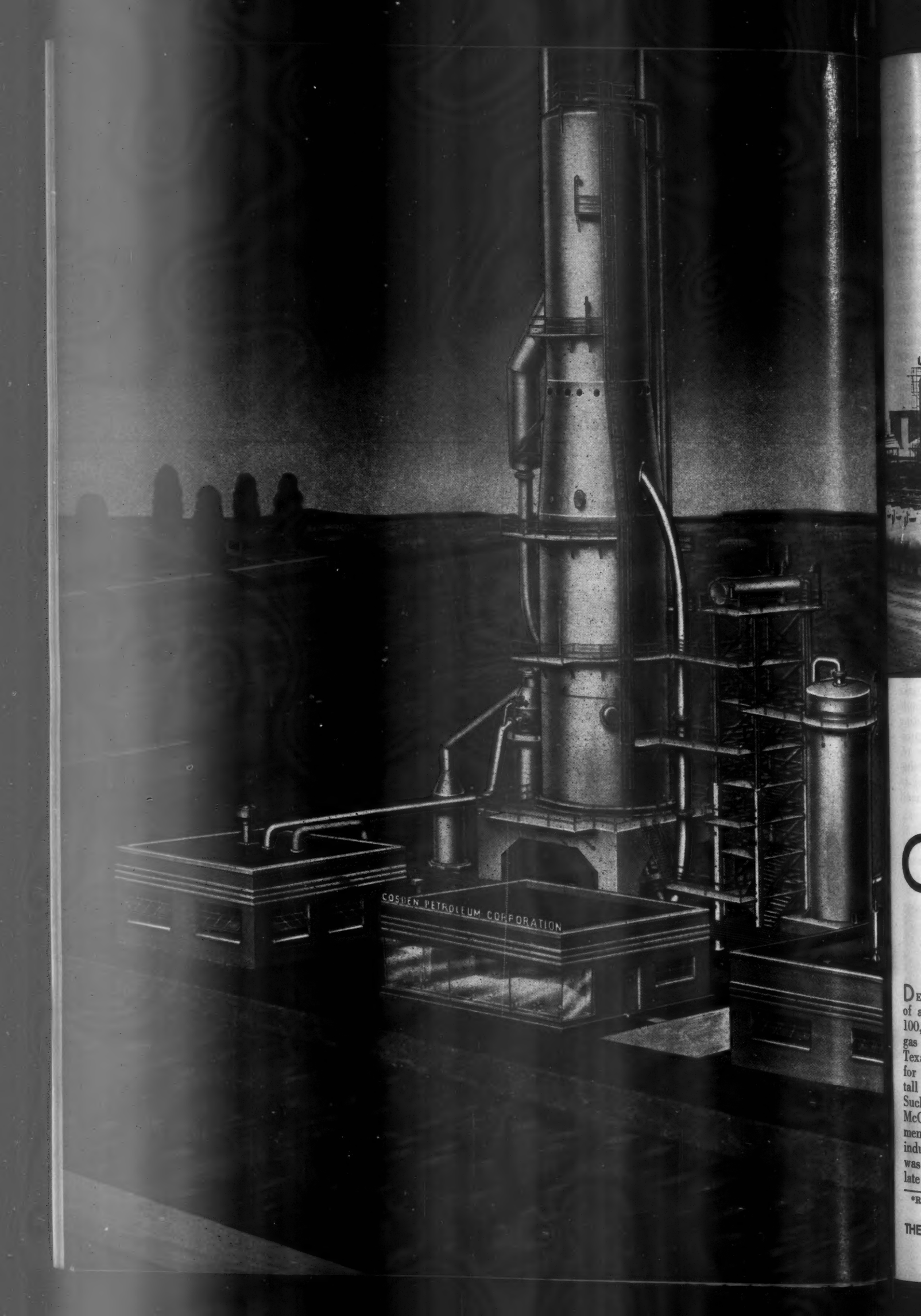
Only recently a prominent research organization began the use of radioactive piston rings in automotive engines, to study more effectively the results obtained in the operation of engines with motor fuels and lubricants. This represents a great deal of work and expense, even to obtain the rings. These must be sent to Oak Ridge to be "activated" in an atomic pile; Oak Ridge and its work for peacetime construction developments are becoming increasingly important to the country and the world. Following activation, rings are stored in "a 300-lb lead box" or container not for the protection of the rings but of human beings who may come in reach of them.

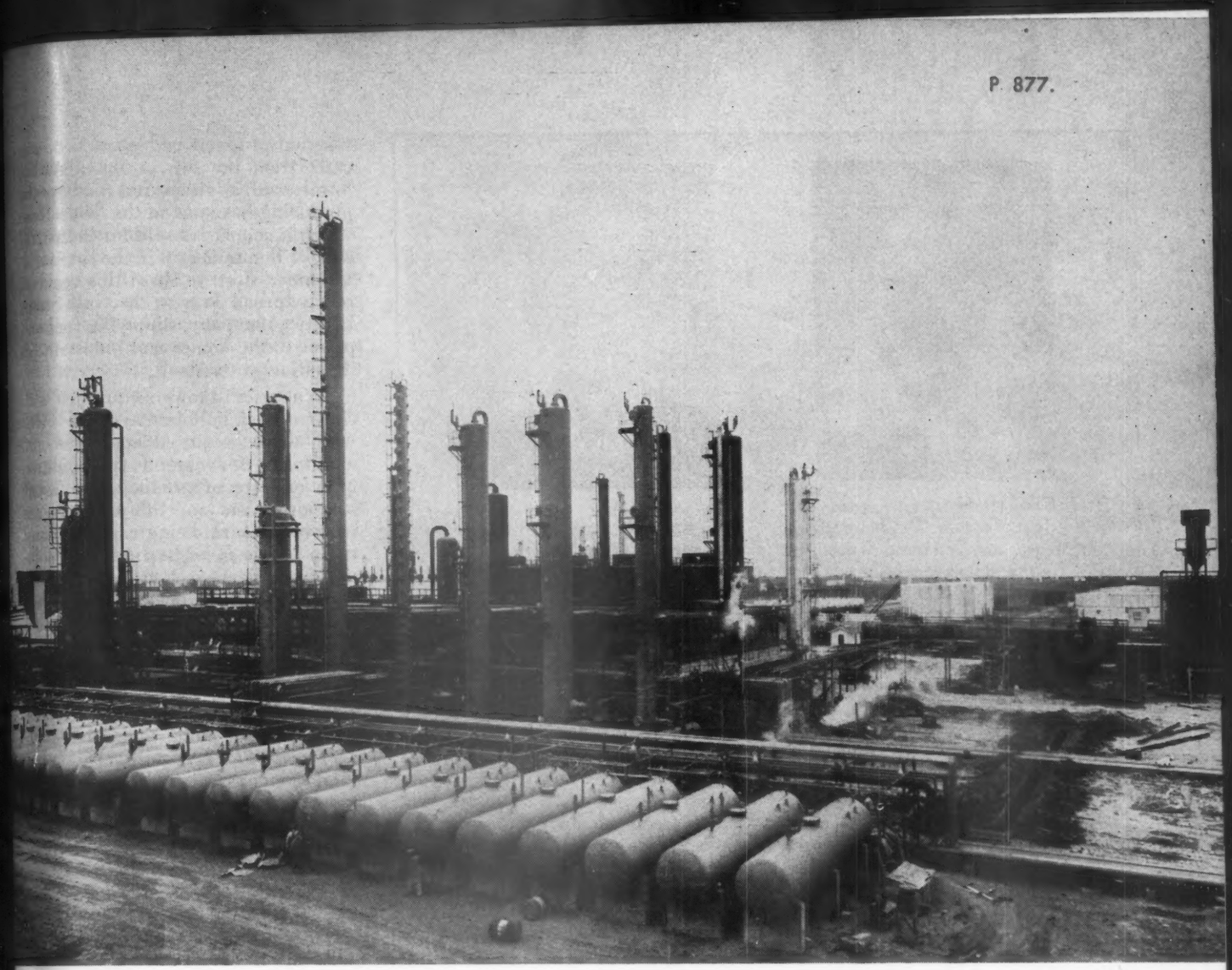
When needed these rings are placed on pistons in a test engine, which is operated under specific conditions with a specific fuel, or lubricant. After a given length of time under test operation, the lubricant, for example, is tested to determine the amount of radioactive metal worn from the ring. This determination is accomplished by counting with a 'geiger counter' the radioactive emanations from the lubricant sample and by methods developed by the scientists the amount of active material is calculated.

Variation in the amount of metal worn from the active ring, then, will indicate the relative lubricating efficiency of the lubricating oil under test. Or it may indicate the effect of a fuel on engine wear, when compared to other and different fuels, similarly tested. By such methods quick, definite determinations of results of use of petroleum products may be made as guides for refiner and user alike. As little as one-millionth of an ounce of metal can be detected.

In manufacturing, and in operating refining processes, radioactive carbon, introduced by synthetic means into constituents of products, or carbon compounds made radioactive in an atomic pile or otherwise, are being used as guide, tracer, and indicator in many refining operations to find out what happens to molecules when passing through the process routines. Different products are traced through pipe lines by incorporating these 'tracer' materials in extremely small quantity in the products. Effects of refinery processing, and chemical treating of various components of the processed fractions may be determined by the use of these tracer atoms. Although most of the work of researchers is closely guarded as to methods and results, it is known that outstanding discoveries have been made already in more than one project.

It thus appears inevitable that this activity, undertaken first in the effort to produce a superweapon when beleaguered on all sides by military enemies, will prove to be a peacetime research tool of the most fundamental importance in a field that will far outshine that which first produced the atomic pile as a practical and large-scale industrial accomplishment.—A.L.F.


COSDEN PETROLEUM CORPORATION



A multiplicity of products, some of which must be stored under pressure makes it desirable to have a large number of individual storage tanks.

GAS CONSERVED TO MAKE CHEMICALS

ARCH L. FOSTER*

DESIGN, construction, and operation of a petrochemical plant to process 100,000,000 cu ft of stripped natural gas per day is no mean feat, even in Texas, land of astronomical figures for oil and gas production, tall men, tall fractionators, and taller stories. Such a plant is that built recently by McCarthy Chemical Company, newest member of the McCarthy interests' industrial family. The chemical plant was dedicated and placed in operation late in 1948.

*Refining and Gas Processing Editor.

The plant is the latest move of the interests owning it, in the strong fight of state and oil and gas company authorities to eliminate wherever practicable the wastage of natural or 'casinghead' gas, invaluable and irreplaceable heritage of the Lone Star State, the nation, and the world. In keeping with that over-all plan, the gas produced in the Stowell and Jackson Pasture fields of southeastern Texas is processed here in the shadow

EXCLUSIVE

of derricks in famous old Spindletop oil field, first of the major producing areas brought in in that region, at the turn of the century. Residue gas is sold for industrial or domestic use as fuel or is returned to the producing horizons to maintain pressures and bring up more hydrocarbon products recoverable in one or more of the associated plants.

Raw gas is produced from the field at above 1000 psig, is collected by field gathering lines, is introduced into the nearby natural gasoline-naphtha-dis-

Glen H. McCarthy, president of McCarthy Chemical Company and head of their many industrial interests.

G. M. McGranahan, vice president and general manager of the Company.

tillate recovery plant where these products, including liquefied petroleum gases, propane, butane, and mixtures of the two, are extracted by oil absorption methods for industrial and commercial products. The stripped gas is transferred to conventional scrubbers in which all trace of absorption oil from the previous operation is removed before entering the chemical plant.

Reforming Naphtha

An additional operation in connection with the hydrocarbon recovery plant is that of reforming the heavy naphtha obtained in the recovery of condensable materials. This naphtha, of saturated or paraffinic hydrocarbon composition and thus relatively low in octane rating, is processed further in a Fish-Engineering-built Cycloversion catalytic reforming unit licensed by Phillips Petroleum Company, to improve its anti-knock properties. Heated to a temperature "in excess of 850 F" in the presence of a granulated bauxite —essentially aluminum oxide—catalyst the charge undergoes molecular rearrangement to produce olefins and isoparaffins mainly with upgrading of its octane values, the amount of improvement depending on the treating conditions maintained in the unit. This production supplies blending naphtha to make up 5000 bbl or more of motor fuel per day; the unit is rated at 3000-3500 bbl per day charge throughput.

The stripped and scrubbed gas is introduced into the oxidation unit of the chemical plant after having its pressure reduced from about 800 psig to some 40 psig. It is mixed with concentrated oxygen gas derived from the air at 90-95 per cent purity; the mixture of gases is brought to the desired temperature and pressure for the required length of time to effect the partial oxidation of the hydrocarbons present to produce formaldehyde, acetaldehyde, methanol, or methyl (wood) alcohol, with smaller proportions, ranging from a very few per cent to traces of other aldehydes, alcohols, acids, glycols, ketones, and others of the huge family of related compounds derivable by oxidation of these hydrocarbons.

Utilizing water as the absorbent in a conventional absorber tower similar in design and identical in principle to those used with an oil absorbent to recover hydrocarbons from the raw gas in the adjoining plant the process recovers the various oxidation products in water solution which solution is removed from the base of the tower. The unreacted gas with unabsorbed reaction products and waste products exits from the top of the absorber tower, and is either returned to the producing horizons in the fields from which it came or is sold for industrial and/or domestic fuel in the surrounding area. Most or all of this residual gas is turned over to the Gulf States Utilities Company, supplying fuel and power to the homes and industries in the adjacent territory.

To a series of towers equipped with conventional bubble trays and fitted with all the required apparatus and auxiliaries for careful fractionation of a mixture of products, the water solution passes and the products are removed in turn, being vaporized and taken overhead or as liquid or solution from the tower bottom as the case may be. The fraction containing formaldehyde and methanol is separated in a tower from which methanol is taken overhead and a water solution of formaldehyde is drawn off the bottom. Although formaldehyde has a lower boiling point than methanol, 5.8 F and 147.7 F respectively, methanol does not associate with or form an azeotropic mixture with water as does formaldehyde so that the formaldehyde-water mixture boils at a temperature above that of methanol.

Oxidation of Methanol

Under present conditions, and at any time the operator chooses, the methanol is oxidized further to make more formaldehyde, by the simple process of mixing with air and heating to the desired temperature and pressure to carry out the oxidation reaction. In this manner the entire methanol production can be converted to the aldehyde if the market demand

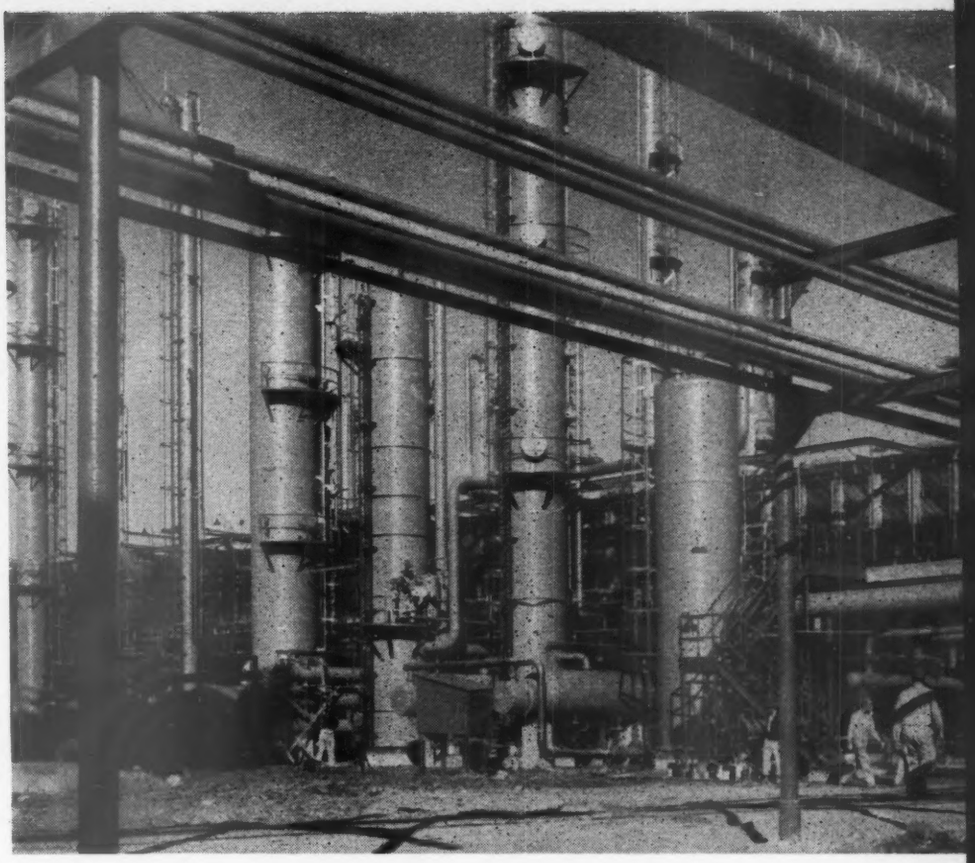
McCarthy Chemical officials: Hugh A. Neal, plant manager; Radio commentator; Leon Dorsey, production superintendent; J. E. Bludworth, consulting engineer and director of Fomac Engineers in designing Winnie chemical plant.

shows a better return for the product or methanol as such can be sold as a chemical intermediate for anti-freeze, industrial or commerical solvent, etc. To oxidize methanol to the aldehyde finely divided copper metal is used as catalyst. Oxygen or air is added to the vaporized alcohol and the reaction products, after removing the undesired impurities, are separated as in the case of the first separation of reaction products from the initial oxidation step.

Theoretically and practically as well, whenever the products are wanted, acteladehyde may be oxidized to acetic acid (vinegar), propane is oxidized to propyl alcohol, propionaldehyde, and propionic acid in turn. These products may be made in this plant by the addition of the required reactors and purifying equipment. The plans of the company are not disclosed on this development. Neither have the operating details of the present processes been divulged for publication. The process now employed was developed and licensed by Fomac Engineers, under the leadership of J. E. Bludworth, well known research and development engineer in this field of oxidation of hydrocarbons.

Oxygen Concentration

One of the main problems solved and results used in the design of the plant is that of concentration of atmospheric oxygen for carrying out the process. The oxygen concentration plant, shown at extreme left in the main view of the plant shown in Fig. 1, is a modified Linde-Frankl unit, the specific design of which was developed and the process licensed by Hydrocarbon Research Inc., the organization led by P. C. Keith, which is the research unit for the Carthage Hydrocol, Inc., the company building the synthetic fuels plant at Bishop, Texas. Air is compressed by eight 800-hp compressors, is cooled by outside aid and then by expansion through a turbine to yield power that is consumed in the process and is then recompressed repeatedly to reach the liquefaction point of oxygen and of nitrogen, finally eliminating most of the nitrogen to give liquid oxygen of the purity required for the purpose. In this way the serious dilution of the residue gas, which occurs with the use of air with its about 80 per cent nitrogen and other gases, is avoided and this residue can be sold and used as fuel as is any other portion of noncondensable natural gas hydrocarbons. No use is made so far of the nitrogen rejected during the process. Most of the equipment in the oxygen plant is constructed of aluminum alloys.



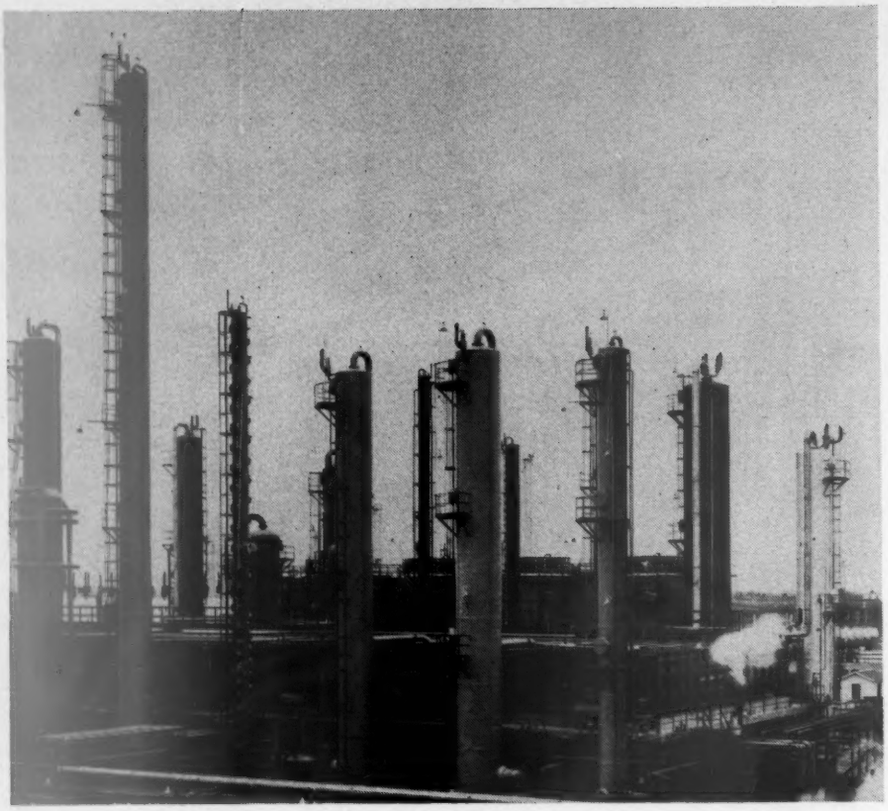
Layout and equipment of these towers show that they employ the same principles of design and operation as those in a refinery or natural gasoline plant. Only charge stocks and products differ essentially from refinery operations.

Units in Plant

Among the units comprising the chemical plant are the gas direct-fired tube still, where the charge is brought to reaction temperature and which the charge enters immediately after being scrubbed free of absorber oil carryover in the conventional scrubbers. Next is the absorption tower with water flowing countercurrent to the uprising reaction vapors and gases. A rather conventional type still removes the products from solution and a series of bubble towers separate the various products in succession according to their boiling points or the boiling ranges of mixtures present. Several towers are required for the oxidation of methanol product to formaldehyde and to separate and purify these two materials, for the recycle of unreacted methanol for further passage through the reactor. Tankage and lines for handling products require special design and equipment, as discussed below.

Many of the products of these reactions are corrosive, either because of inherent corrosiveness of the desired product or due to the presence of small amounts of corrosive oxidation products or even of very minute quantities of oxygen which may be dissolved in the liquors. Wherever formaldehyde is found corrosion is present and special materials must be used to prevent destruction of equipment. In the process equipment stainless steel is employed to prevent formaldehyde or its impurities from attacking carbon steel or less resistant alloys. Fractionators, vapor lines, condenser coils, and exchangers are stainless steel, as are pumps handling formaldehyde.

In storage the formaldehyde tanks are lined with resin of the phenol-formaldehyde condensation product type to avoid contact between aldehyde and metal. Similarly tank cars, of which the company has a considerable number of 10,000 gal capacity, are lined with the same resin coating. This coating is designed to resist 50 per cent CH_2O, up to 190 F. Because formaldehyde must be prevented from reaching too low a temperature, these cars all are insulated with a glass wool type of material (Fiberglas) to a depth of 6 in. Steam is employed in the tanks and elsewhere wherever practicable to maintain the aldehyde



Appearing as a Forest of Towers, these highly efficient bubble-tray fractionators separate products, concentrate each one to the required purity, prior to storage or shipment; fractionation is the largest single operation there.

at a temperature high enough to prevent its polymerizing to paraformaldehyde or other polymerization product. All the company's tank cars are so lined and insulated to permit use of any car for formaldehyde shipment.

Glass insulation is used generally for insulating various units and vessels in the plant. Some equipment was covered with glass blocks, on others the spun-glass type of material was used. Incidentally, because this area is located in the Caribbean hurricane belt all structures are designed to withstand wind pressures up to 125 miles per hour, a figure not excessive when the terrific power of the tropical storms in this vicinity is considered.

Auxiliary Units

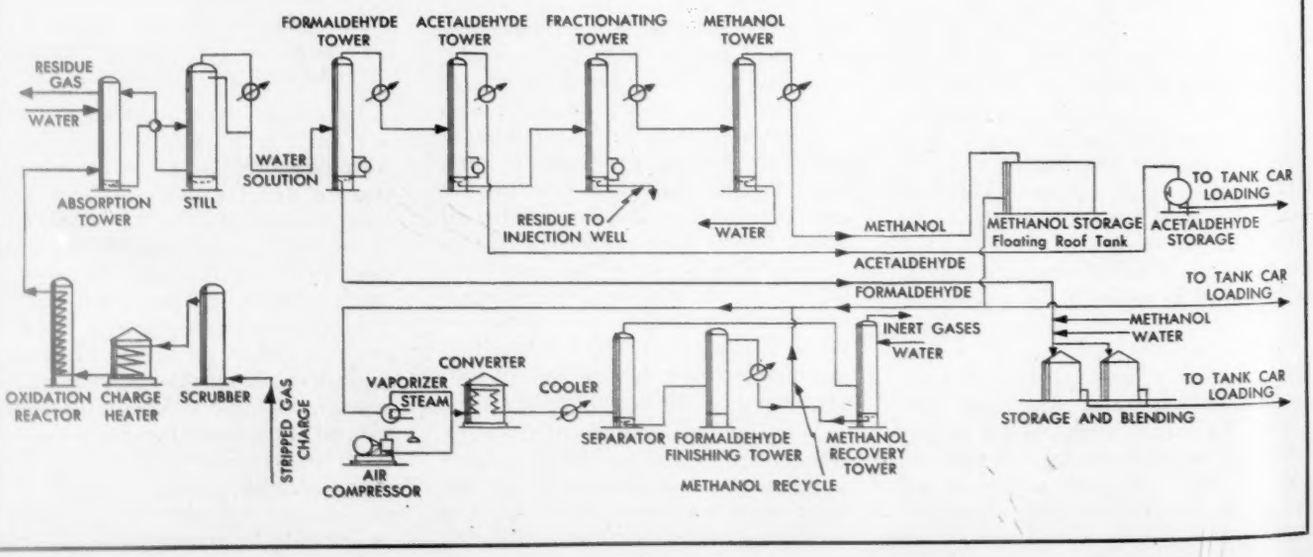
Electic power for the plant is purchased from a utility company, Gulf States Utilities, which consumes much of the gas from the plant and the area. The plant has its own utilities otherwise. More than 200,000 lb of steam per hour is produced by the three (Union Iron Works) induced-draft boilers; gas is the universal fuel at the plant. Two company wells supply all water needed and it is cooled in two Fluor towers, one a four-cell and the other a two-cell for the oxygen plant, both induced-draft towers. This water is treated with the required amounts of chlorine, sodium metaphosphate, and sulphuric acid to meet the process' exacting requirements. The unit employed is by Hungerford & Terry.

This plant was designed by Wyatt C. Hedrick, Inc., and built under the direction of Tellepsen Construction Company, from the process developed by Fomac Engineers, handling pilot plant investigations.

Much has been written recently regarding the chemistry of the oxidation of hydrocarbons to chemicals but nothing has been disclosed of the exact chemical engineering process conditions that have been worked out for these large scale industrial plants. The oxidation steps are relatively simple. Numerous side reactions occur and in any reaction an equilibrium is reached between several products, which can be and are formed inevitably, even though only one product may be desired by the chemical engineer.

For example, simple oxidation of methane, largest component of stripped natural gas used in the McCarthy plant, leads first to methyl

Simplified flow chart showing essential steps and operations in the chemical plant.



OIL REFINING AND CHEMICAL PLANT

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MAIN OFFICE AND PLANT
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Aerial view of McCarthy Chemical Plant at Winnie, Texas. The main reaction and fractionating units are at right, which shows towers, water cooler, and horizontal products storage tanks. The oxygen concentration unit is at far left.

alcohol or methanol:

$2CH_4 + O_2 = 2CH_3OH$. (methyl alcohol or methanol).

This product may be oxidized in turn to formaldehyde:

$$2CH_3OH + O_2 = \underset{\text{Formaldehyde}}{2CHOH} + \underset{\text{Water}}{2H_2O}.$$

Formaldehyde is easily oxidized further to formic acid or still further to carbon dioxide and water as follows:

$$\underset{\text{Formaldehyde}}{2CHOH} + O_2 = \underset{\text{Formic acid}}{2HCOOH}.$$

$$2HCOOH + O_2 = 2CO_2 + 2H_2O.$$

Carbon dioxide and water are, of course, the two end products of oxidation (combustion) of hydrocarbons.

Oxidation of Hydrocarbons

In any simple oxidation process operating on hydrocarbons some of each of these reaction products are certain to be present in the reaction mixture. A dynamic equilibrium will be attained and maintained in a unit properly operated in which a maximum yield of the most desired products will be obtained with minimum quantities of the other products. Unlike metathetical reactions in inorganic chemical operations, the equilibrium cannot be displaced, practically, far enough in the direction of the most desired product so as to leave only infinitesimal amounts of the other products. In inorganic reactions such as precipitation of silver or chloride ions from solution the percentage of either of these ions remaining in solution after addition of the other ion approaches the vanishing point very closely.

Wanting formaldehyde in maximum yield, it is unavoidable that some methanol, some formic acid, and even small amounts of CO_2 and H_2O will be produced in the reaction with concentrated oxygen. The function of the chemical engineer in this problem is to determine the operating conditions of temperature, pressure, concentration of reacting materials, time period of exposure to reacting conditions that will give the largest output of the most desired material. Because the number of variables is large in this reaction and the number of combinations of conditions usable approaches the infinite, the engineer and the process researcher have a complicated job. The operating data are expensive to obtain, hence they normally are not disclosed for publication, being considered property and know-how of the company that develops them.

Analogously, these identical reactions may occur with any other hydrocarbons present. Stripped natural gas contains mainly methane, CH_4, considerable ethane (the ethane concentration varies widely in different samples), and widely varying amounts of propane, small quantities of butane and traces only of higher hydrocarbons. Consequently when this mixture is oxidized under any given set of conditions, each will be converted to different products in different percentages and the mixture of products and quantities seems at first glance to be hopeless to separate efficiently without prohibitive costs. Because of this complicated situation, a large number of towers is required to make different products of the desired purity and quality. Ethane yields ethyl (grain) alcohol, acetaldehyde, acetic acid; even ethylene glycol may be formed by the addition of two oxygen atoms to the two carbons in the ethane molecule. In addition to alcohols propane will yield aldehyde and acids, some glycols and a ketone, CH_3-CO-CH_3, acetone, an important solvent and chemical intermediate. Correspondingly butane and higher molecular weight hydrocarbons yield more complicated mixtures of products.

Products sold from this plant include 37 per cent formaldehyde in water solution; seventy per cent of the entire national production of this material is used in the preparation of plastics, mostly in condensation with phenol (Carbolic acid). The acetaldehyde formed is used in paints, plastics, coatings, and chemicals. Most of these products are found in many commercial and industrial materials but their presence is not known to the ultimate purchaser-consumer; among these are telephone sets, helmets, furniture cabinets, anti-freezes, waterproofing materials, varnishes, bonding agents as for plywood and waterproof adhesives, and moulded parts for many household and commercial items.

Among the future plans of the company is the water transport of chemical products to be shipped from the McCarthy terminal near Port Neches 30 miles away. That terminal now has 155,000 bbl of liquid storage along with dock facilities and access to the intracoastal canal is available 15 miles from the plant. ★ ★ ★

Hydrocarbon absorption and fractionation process design methods

Part 20 (Conclusion) Design Procedures

By WAYNE C. EDMISTER*

THE design of hydrocarbon separation plants involves much more than making the theoretical plate-component distribution calculations that have received so much attention in the technical literature. In addition to the internal plate-to-plate calculations (equilibrium and heat and material balances), the following other process design steps are used: (a) preliminary component distribution estimates and layout of tentative flow sheet, (b) establishing pressure and the reboiling and refluxing temperatures, (c) heat balances to develop heat exchange arrangements, (d) establishing recycle streams and their effects on operations, (e) application of pilot plant and analytical laboratory data to the development of the commercial design, and (f) thermodynamic analysis of the entire process to find efficiency of plant and its units with changes as may be indicated to improve efficiency.

PRELIMINARY COMPONENT DISTRIBUTIONS

When a complex mixture is to be separated into three or more products, which requires two or more columns, there are many alternate flow diagrams possible but no selections can be made until some preliminary calculations are made. For this purpose it is not usually necessary to make detailed calculations but only to rough out the process.

Where speed is essential and there are several designers available to work on the process calculations, work may be started simultaneously on all towers of a multicolumn hydrocarbon separation plant by making preliminary component distribution calculations to approximate the charges and the products from the various towers. These approximations must be consistent because of the fact that the products from some towers are the feeds to others.

Thus it can be seen that there are two reasons for making preliminary component distribution estimates in the design of multicolumn systems. Such estimates are also necessary in the design calculations for each individual fractionator, where the terminal conditions are established by bubble and dew point computations.

Fig. 89 illustrates one method of making such preliminary component distribution estimates. This graph is similar to the one in Table 75, which summarized the Hengstebeck method in Part 15 (*The Petroleum Engineer*, August, 1948) except that the relative volatility is plotted on a log scale in Fig. 89 instead of the rectangular scale used in the similar plot in Table 75.

The scales of the graph in Fig. 89 are log d/b vs log α, d/b being the ratio of mols in distillate to mols of same component in bottoms while α is the relative volatility. With values of d/b and α ranging from 0.001 to 1000 the chart will cover a multicolumn system containing about four or five towers. The principle of this plot is very simple. There is no theory or equations. It is simply an empirical method of estimating the distribution of other components from that of two key components. The results may be approximate but they are consistent and have the virtue of not overlooking either the components of very high or those of very low volatilities.

It happens that plots of d/b vs α on log-log scales give substantially straight lines for equilibrium flash vaporization (separation with no plates and no reflux) and also for precise fractionation with plates and reflux. This fact is the basis for the estimation method shown in Fig. 89, which is illustrated for the separation of a complex mixture into four fractions, as indicated by the small flow sketch in the upper left hand corner. In this system there are three towers, the first one being fed the full range mixture while the other two fractionate the products from the first.

Four straight lines are drawn on the graph in Fig. 89. Each of these lines represents a separation, the efficiency of which is proportional to the slope. The curve of lowest slope is for the equilibrium flash vaporization of the entire mixture to separate it into two fractions equivalent in quantity, but not in quality, to the desired products from fractionator No. 1. A plot of d/b ratios from E.F.V. calculations versus α, gives a straight line on these scales and defines one limit of the separation, similar to Fig. 55 in Part 14 (July, 1948). The other limit, i.e. perfect separation between two adjacent components with no overlap whatever so that values of d/b are either infinite or zero, is represented by a vertical line drawn at relative volatility value for the key components.

It is of interest to compare Fig. 55 and 89. Both do essentially the same thing. The latter has more meaning for mixtures defined by component composition while the former has more significance for mixtures defined by true boiling point distillations. Neither Fig. 55 or 89 possess any feature that permits drawing the proper products lines for a given number of plates and reflux. These approximation diagrams only tell the relationship between products. It is necessary to make equilibrium stage calculations to determine the number of plates.

The three fractionation lines on Fig. 89 are drawn with the same slope, which is the same as saying that the separation is of the same efficiency in all three columns. Different slopes could have been used for each column, thus varying the separation or overlap. After drawing these lines and making the preliminary component material balances for each column, the next step is to find the numbers of plates and the reflux ratios required to obtain these separations. This may be done by any of the many methods that have been developed, discussed and illustrated in Parts 12 through 16. The writer's method for making multicomponent fractionation calculation is summarized in Fig. 90.

PROPOSED FRACTIONATION CALCULATION METHOD

In Part 9 the writer's method of making absorption and stripping calculations was summarized in Fig. 38, which included equations, charts and procedure of application. A similar summary has been made of the writer's multicomponent fractionation design method and is presented in Fig. 90, where equations charts and calculation procedure are also given.

Both of these design methods employ effective absorption and stripping factors calculated from the terminal values of A=L/KV and S=KV/L. The charts in Fig. 90 are small scale reproductions of larger scale charts in previous chapters. The fractionator flow diagram is Fig. 39 in Part 10. The A_e (or S_e) graph is Fig. 29 in Part 5. The other graphs are Fig. 57, 60, 61, and 62 of Part 16.

The lower three graphs are for making corrections to the effective A and S factors. These corrections are only necessary for very precise results with three or more distributed components.

This proposed multicomponent fractionation design method finds the distillate and bottom products for given or

*Carnegie Institute of Technology, Pittsburgh, Pennsylvania.

EXCLUSIVE

assumed number of plates, reflux and boil-up quantities and estimated temperatures.

In the plate efficiency discussion in Part 18 a new definition of plate efficiency was proposed. In this proposal the effective absorption and stripping factors would be combined with the efficiency factors so as to introduce the approach to equilibrium locally rather than try to apply the Murphree or the overall efficiencies, the last two being objectionable because of difficulty of properly applying either to different components for which the efficiencies vary.

This new plate efficiency suggestion is not incorporated in the summary because no quantitative evaluations of the new plate efficiency factor have been developed yet.

RAGATZ STRAIGHT-LINE ABSORPTION CHART

A recent Clark Brothers advertising bulletin has distributed via the mails an empirical method proposed by Ragatz[10] for analyzing natural gasoline plant absorbers in such a way as to give lines that are straight on per cent absorbed versus effective absorption factor, which is said to be a significant development. While an ingenius method of plotting absorber performance data, it is difficult to see how it can be of any help in designing new absorbers.

This chart, which was first proposed by Ragatz and Richardson[9] and later revised by Ragatz, is somewhat of a reconstructed Kremser-Brown plot (Fig. 28, Part 5) with changes as follows: (a) the absorption (or stripping) factor function scale of Fig. 28 is laid out from 80 per cent to 99.2 per cent in such a way that the scale spreads out as the percentage increases, this scale being called "per cent absorbed;" (b) the effective absorption factor scale is unchanged, being rectangular, but A_e is computed from the wrong conditions using the correct equation; and (c) the number-of-plates parameter was omitted. These points are discussed further below.

In the original development of the Kremser-Brown chart an efficiency function was plotted against absorption (or stripping) factor with lines of different number of theoretical plates. For the special case of a completely denuded lean oil (i.e. containing none of the component being absorbed) this efficiency function represented the per cent absorbed. When the lean oil contained some butane, for example, the chart reading had to be corrected accordingly. Souders-Brown made this correction. The writer's absorption design method, summarized in Fig. 38 of Part 9 and using Fig. 28 of Part 5, makes this calculation in a more convenient way. The Ragatz method of plotting ignores the correction for the presence of solute in the solvent. In many cases it is negligible but not always.

Ragatz uses the writer's equation for calculating the effective absorption factor but not in the original form. The equation for the effective absorption factor was developed in Part 5 and is

$$A_e = \sqrt{A_n\,(A_1+1)+0.25}-0.5\;\ldots\;(59)$$

In this equation A_1 and A_n are terminal (i.e. top and bottom plates) values of the absorption factor. Ragatz has rewritten this equation with different symbols using ratios of lean oil to lean gas and rich oil to rich gas for the terminal L/V ratios and the K values at the temperature of the rich oil. These L/V values do not allow for the changes in rich gas or lean oil on the bottom and top plates, respectively. The correct values of L/V are for the terminal plates, not the terminal streams. In some cases there will not be much difference but in others there will be. It seems best to be as consistently correct as possible in computations of this kind. The use of bottom plate K values for the top plate is a more serious error. There seems to be no excuse for making this approximation. It saves very little time and introduces a source of inaccuracy.

The lack of a number-of-plates parameter in the Ragatz chart makes it of little value in design. In the Kremser-Brown charts and in Fig. 28 (Part 5) lines were included for different number of plates. These lines were curved and difficult to interpolate. In constructing his chart Ragatz has straightened them out. He has done more than that. He has included an automatic variation in the plate efficiency factor in his scales. It is true that plate efficiency varies for different components in absorbers. This was pointed out in Part 18. However, this variation is dependent upon many factors that should not be ignored, especially in going from one type of plate to another or in changing the type of lean oil or even the components being recovered. With a great deal of performance data on absorbers recovering butanes with the same type of lean oil, one would expect good agreement for an empirical correlation. For unusual systems where this vast experience is not available, it is dangerous to use such an empirical method.

REFRIGERATED OPERATIONS

Where possible cooling water is used to condense reflux and cool lean oil for hydrocarbon separation operations. When butanes recovery is the prime objective this is usually satisfactory, yet it frequently involves going to pressures as high as 300 psi. With propylene and even ethylene as the objectives the use of cooling water will involve excessively high pressures and/or recycle rates. At higher pressures the relatively volatilities are lower which makes the separation more difficult. This makes it desirable to go to temperatures lower than obtainable with cooling water. In some separations, such as the enrichment of natural gas by removal of nitrogen and

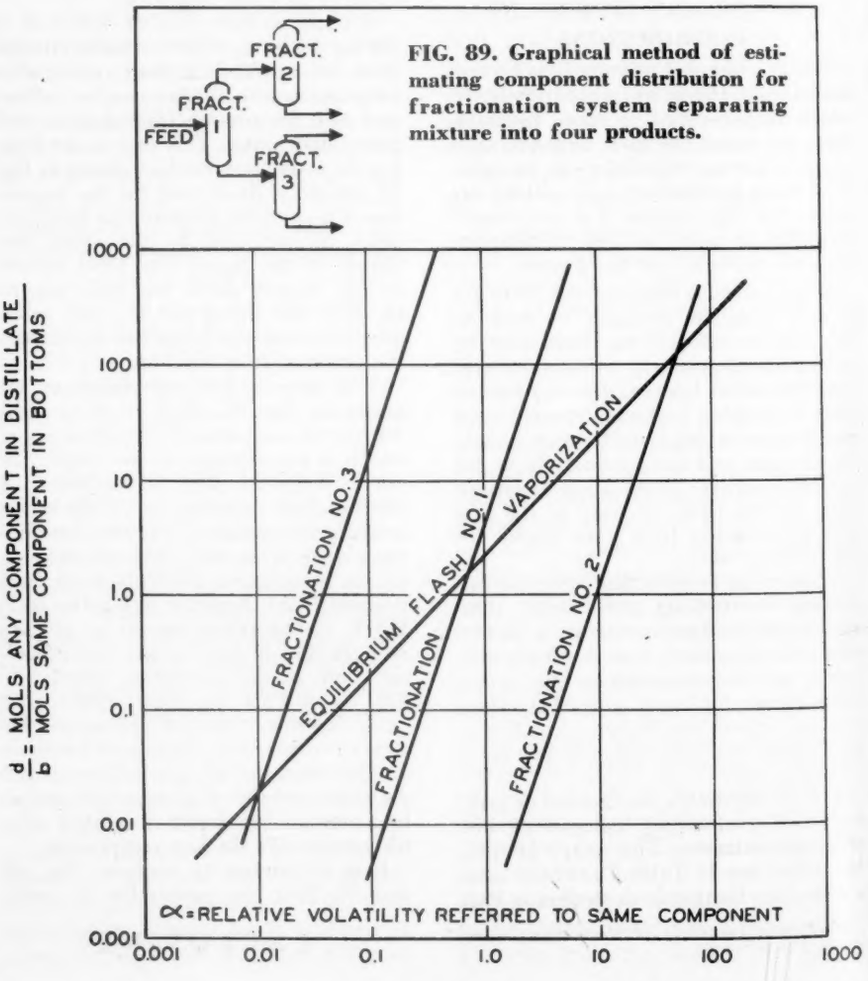

FIG. 89. Graphical method of estimating component distribution for fractionation system separating mixture into four products.

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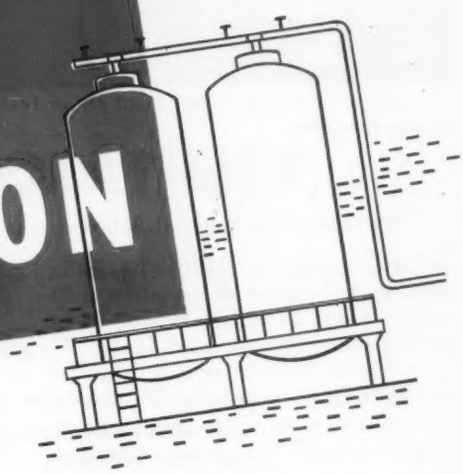

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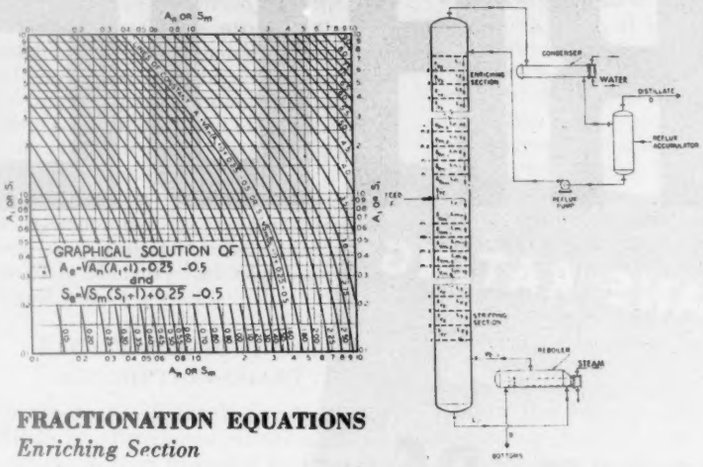
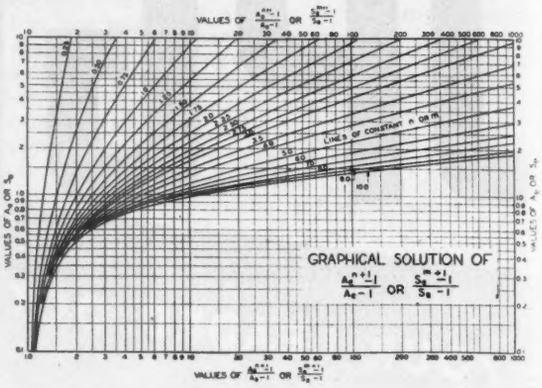
FIG. 90. SUMMARY OF EDMISTER MULTICOMPONENT FRACTIONATION DESIGN METHOD

This method employs effective A and S factors, which are functions of terminal and midpoint conditions for each section, with fractionation equations relating concentraton changes for the distributed components across both enriching and stripping sections with functions of absorption and stripping factors and the number of theoretical plates. Results from enriching and stripping equations are meshed at the feed plate and products computed. Absorption factor, A=L/KV. Stripping factor, S=KV/L.





FRACTIONATION EQUATIONS

Enriching Section

$$\frac{v_m}{d}=\left[\phi_1(A)+\frac{L_d}{DK_d}\phi_2(A)\right]-\frac{v_f}{d}$$

Stripping Section

$$\frac{v_m}{b}=\left[\phi_1(S)+\frac{V_bK_b}{B}\phi_2(S)\right]-1$$

Feed Plate Mesh

Ratio of d/b is found from above results by the following equation:

$$\frac{d}{b}=\frac{v_m/b}{v_m/d}$$

By component material balance

$$f=d+b;\ d=\frac{f}{\frac{b}{d}+1};\ b=\frac{f}{\frac{d}{b}+1}$$

Where:

D, B, L_d, V_b = total molal quantities.

v_m = mols of any distributed component in vapor from feed plate.

v_f = mols of any distributed component in vapor portion of feed.

d and b = mols of any distribution component in distillate and bottom products, respectively.

K_d and K_b = vapor — liquid equilibria constants in reflux accumulator and reboiler, respectively.

EVALUATION OF FACTOR FUNCTIONS

Series

$$\phi_1(A)=A_1A_2A_3\ldots A_n+A_2A_3\ldots A_n+\ldots+A_n+1$$

$$\phi_2(A)=A_1A_2A_3\ldots A_n$$

Equations for stripping are analogous. These equations evaluated from values of A (or S) for each plate.

Short cut

Based on use of effective factors which are functions of terminal conditions.

$$\phi_1(A)=\frac{A_e^{n+1}-1}{A_e-1}\text{ and }\phi_2(A)=A_1^n$$

For two theoretical plates

$$A_e=\sqrt{A_n(A_1+1)}+0.25-0.5\text{ and }A_1=\sqrt{A_1A_n}$$

Equations for stripping are analogous. Use chart above, left, for evaluation of A_e and S_e functions. Use chart above, right, for solution of A_e and S_e equations.

Short cut for more than two plates

Find A_e and A_1 (or S_e and S_1) from terminal conditions, A_1 and A_n (or S_1 and S_m), by above two-plate equations.

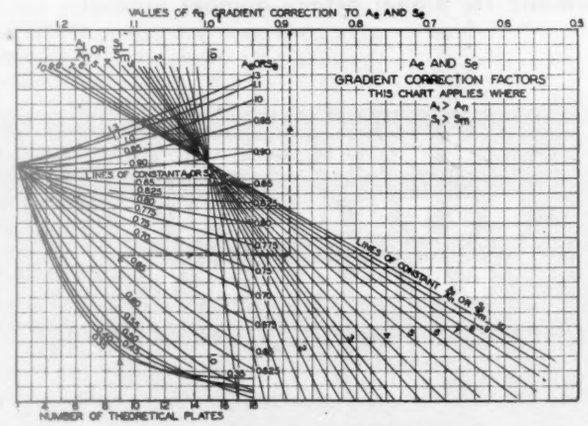
Correct A_e and A_1 (S_e and S_1) for gradient and curvature with factors from charts below.

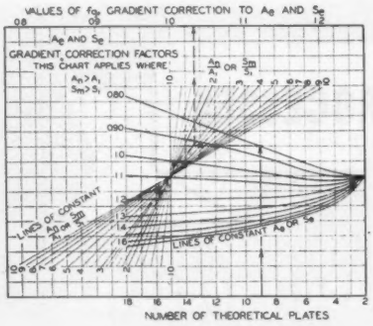
$$A_{e(corr)}=A_e\times f_g\times f_c$$

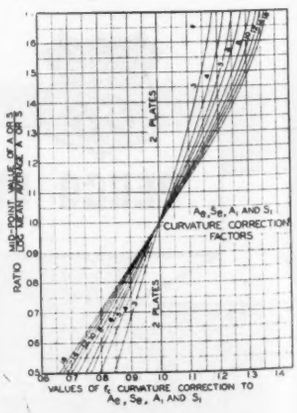
$$A_{1(corr)}=A_1\times f_c$$

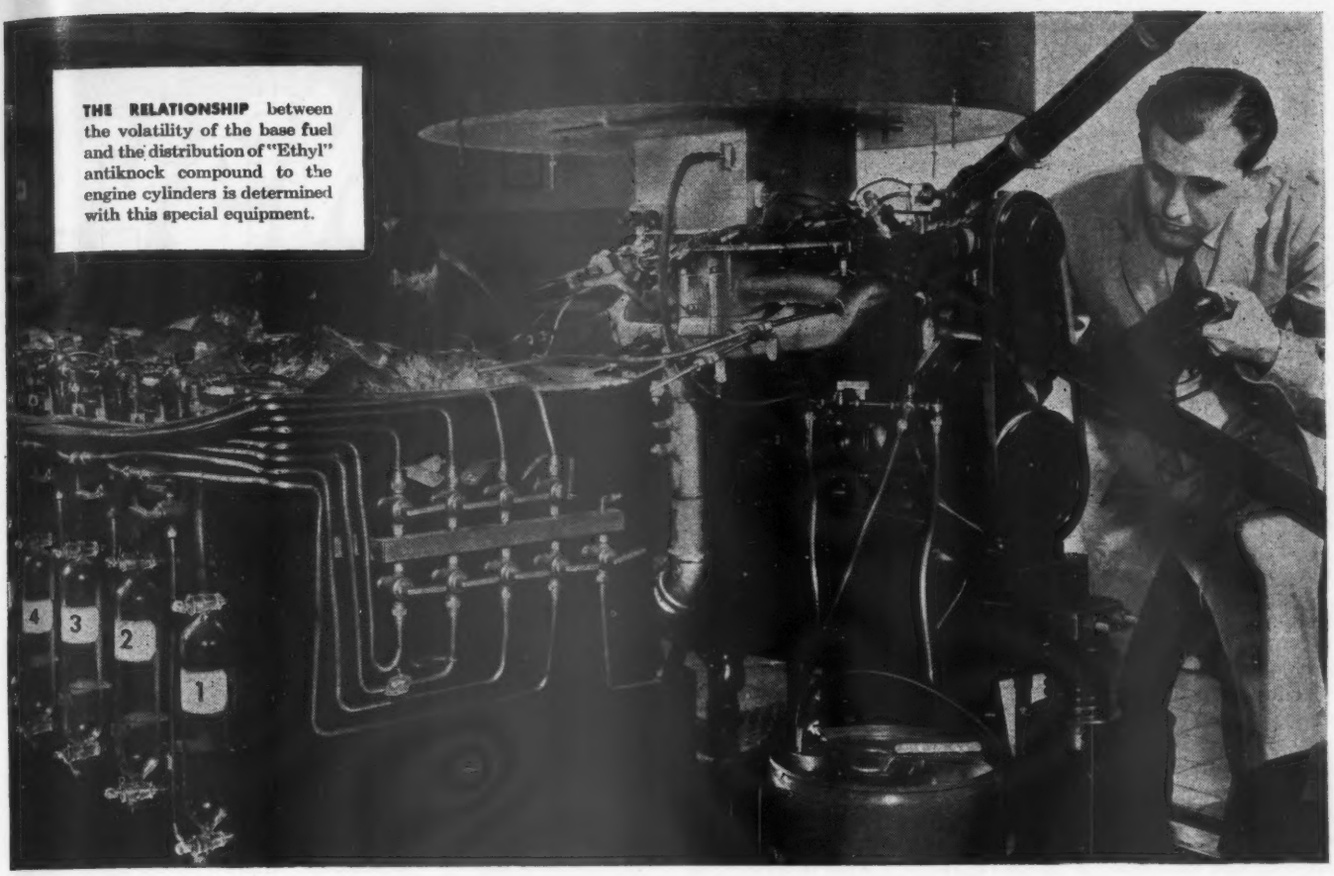
f_g = function of (number of plates, A_e, and A_1/A_n).

f_c = function of (number of plates, and ratio $\frac{\text{mid point value of A}}{\text{log mean average A}}$)


VALUES OF f_g GRADIENT CORRECTION TO A_e AND S_e
A_e AND S_e
GRADIENT CORRECTION FACTORS
THIS CHART APPLIES WHERE
$A_1 > A_n$
$S_1 > S_m$
LINES OF CONSTANT A_e OR S_e
LINES OF CONSTANT $\frac{A_n}{A_1}$ OR $\frac{S_m}{S_1}$
NUMBER OF THEORETICAL PLATES


VALUES OF f_g GRADIENT CORRECTION TO A_e AND S_e
A_e AND S_e
GRADIENT CORRECTION FACTORS
THIS CHART APPLIES WHERE
$A_n > A_1$
$S_m > S_1$
LINES OF CONSTANT $\frac{A_n}{A_1}$ OR $\frac{S_m}{S_1}$
LINES OF CONSTANT A_e OR S_e
NUMBER OF THEORETICAL PLATES


RATIO MID-POINT VALUE OF A OR S TO LOG MEAN AVERAGE A OR S
2 PLATES
3 PLATES
A_e, S_e, A_1 AND S_1 CURVATURE CORRECTION FACTORS
VALUES OF f_c CURVATURE CORRECTION TO A_e, S_e, A_1 AND S_1



THE RELATIONSHIP between the volatility of the base fuel and the distribution of "Ethyl" antiknock compound to the engine cylinders is determined with this special equipment.

REAPPRAISING FUEL VOLATILITY

THERE are some refiners who have an excess of high-volatility stocks of good antiknock quality. There are others who, because of the use of new refining processes, may find it advantageous to produce quantities of high-antiknock stocks of relatively low volatility. The ability of such refiners to blend these stocks into motor gasoline might result in greater flexibility and economy of refinery operation.

The needs of automotive transportation are served best by the greatest possible flexibility in the refining of petroleum products. It is desirable, therefore, that automotive designers make every effort to minimize the sensitivity of engines to fuel volatility.

The problem of using gasolines that contain high-boiling fractions, in particular, presents a challenge to the automotive engineer, because it is not desirable that distribution to the cylinders be obtained through excessive heating of the intake manifold. Such heating not only reduces volumetric efficiency and power output, but tends to depreciate the antiknock quality of highly sensitive cracked fuels.

Problems of vapor-lock

The use of gasolines containing the lighter hydrocarbons also presents problems of engine design. High-volatility gasolines, under some conditions of service, may result in vapor-lock of fuel systems, but experience indicates that much can often be done in the design of both engine and chassis to increase their tolerance of more volatile fuels. When engines and vehicles can utilize the lighter fuels without the occurrence of vapor-lock, the advantages of easier starting and quicker warm-up are made available to users of automotive vehicles.

Volatility of gasolines is an important factor in connection with the formulation and utilization of "Ethyl" brand of antiknock compound. As a consequence it has played and will continue to play an important part in the program of the Ethyl Research Laboratories.

Research related to gasoline volatility is only one of the many services provided by the Ethyl Laboratories for oil companies. A comprehensive and continuous research program provides information which assists refiners directly in the economical production of satisfactory gasoline and furnishes basic data which serve as a foundation for development programs related to gasolines, engines, and crankcase oils.

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retaining methane, refrigeration is a must.

Two recent articles, by Bell[1] and by Heath et al[6] on the use of refrigeration in natural gasoline plants show the effects of lean oil temperature on recovery and also on the equivalent amount of lean oil. Heath et al[6] considered propane as the refrigerant, using the Mollier charts for pure-propane and plant-propane given by Laverty and Edmister[7].

A mixture is less efficient as a refrigerant than a pure component because of the spread between the bubble and dew points which makes it necessary to compress a mixture to a higher pressure to condense it than would be necessary for a pure component that evaporated at the same temperature and pressure. This can be seen by studying the Mollier diagram for propane and plant propane and computing refrigeration cycles for each fluid.

In addition to chilling lean oil it is frequently desirable to refrigerate the top of a tower. Fig. 91 gives two examples of the use of refrigeration to fractionators. In Fig. 91A a cascade two-refrigerant system is used to condense reflux. With such a scheme very low temperatures such as those required to separate methane and ethylene or even nitrogen and methane, may be obtained. This flow sheet was given by Laverty and Edmister[7]. Refrigerant No. 1 might be propane and refrigerant No. 2 might be ethane.

In Fig. 91B another type of system is illustrated. In this scheme the refrigerant is evaporated in the reflux condenser, thus absorbing heat and is then compressed after which it is condensed in the reboiler, thus giving up heat. In this system heat is pumped from the low condenser temperature to the higher reboiler temperature by the compressor. Such a system is practical only for towers with a small temperature difference between top and bottom or, in other words, columns handling a narrow boiling mixture.

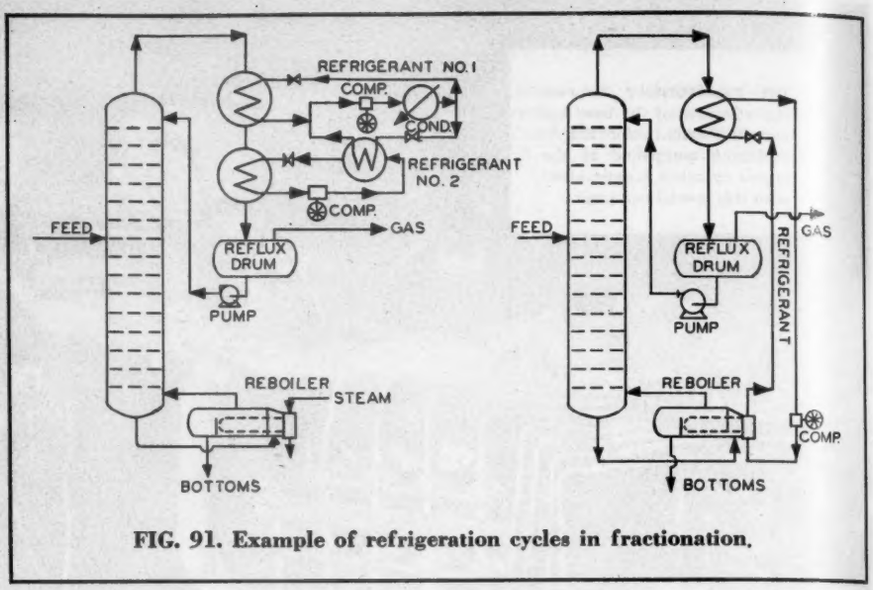

FIG. 91. Example of refrigeration cycles in fractionation.

HEAT AND MATERIAL BALANCES

Most processes for the separation of petroleum hydrocarbons, such as absorption, distillation, etc., are dependent upon differences in equilibrium concentrations of the various components in both phases. The rate of approach to equilibrium is determined by the efficiency of contact between the phases and upon diffusion. In addition to diffusion and equilibria, heat and material balances play a very important part in the process design of hydrocarbon separation equipment. Temperature difference is the heat transfer driving force while concentration difference is the material transfer driving force. In fact, heat and material balances are probably of more importance in design than either diffusion or equilibrium calculations. In many cases plant operating data are available to make the latter unnecessary but the former are always necessary.

While phase equilibria data predict the concentrations of the phases, the amount of each phase produced can be determined only by a consideration of overall and component material balances. A transfer of material from one phase to another is usually accompanied by thermal effects, caused by vaporization, condensation, and/or heating and cooling of various fluids. Since all systems must approach or come to a thermal as well as a concentration equilibrium, heat balance calculations must be made to determine the equilibrium temperatures. Thus, it is evident that heat and material balance calculations must be made simultaneously with the phase equilibria calculations.

It is customary to assume that heat transfer equilibrium is approached in bubble plates to the same degree that material transfer is approached. Although this may not be the case, it is a convenient basis for making design calculations.

Heat and material balances around an entire system and around parts of it are usually made in design work. For example, intra-column flows of liquids and vapors may be determined by making heat and material balances around a section of a fractionating column.

Component heat and material balances are frequently necessary in design calculations. For these, fractional component analyses are required for this type of balances. Two types of heat balances are employed; net and gross heat balances. In the former the heats liberated or absorbed by each and every one of the component streams, or fractions, are computed individually and on a component basis (i.e. each component is followed through individually) totalized to find the reboiler or condenser duty, whichever is required. In making gross heat balances, the total heats above some common reference point such as liquid at 32 deg F are computed for all the streams as they enter and leave the unit and the "inputs" and "outputs" totalized to make a heat balance.

In making even net component heat balances it is necessary to make some assumptions or estimates concerning the heats of mixing and unmixing and include these in the calculations. It is customary to neglect these heats of mixing, which is the same as assuming ideal solutions, and add enthalpies for the components on a weight basis. This is satisfactory everywhere that the ideal K constant values can be used. Deviations of ideal mixtures invalid both simplifications.

For gross heat balances it is necessary to have enthalpy values for the mixtures. These may be found by summing the values for components or they may be constructed from data that include deviations from ideal solutions.

Because of increasing operating pressures and increasing number of non-ideal systems that are being encountered more and more in recent years, it is becoming necessary to develop deviation factors for correcting ideal K constants and enthalpies. It would be worthwhile to link these two together.

DESIGN BY PILOT PLANT METHODS

For special or new types of separations, it is often necessary to carry out pilot plant studies to obtain the design factors. These pilot plant results are then analyzed and interpreted by applying fundamental properties and theoretical methods to the experimental data. This approach has been used in developing hypersorption, azeotropic and extractive distillation, etc. It is sometimes used on special fractional distillation processes, such as the precise fractionation of naphtha to make aviation gasoline base stock components.

Special laboratory equipment is available for this type of work. A drawback of this technique is the large volumes of material and samples that must be handled in order to get sufficient accuracy under steady flow continuous operation. For this reason this type of apparatus is almost limited to a refinery or large laboratory location.

Equilibrium flash vaporization of crude oils under atmospheric and vacu-

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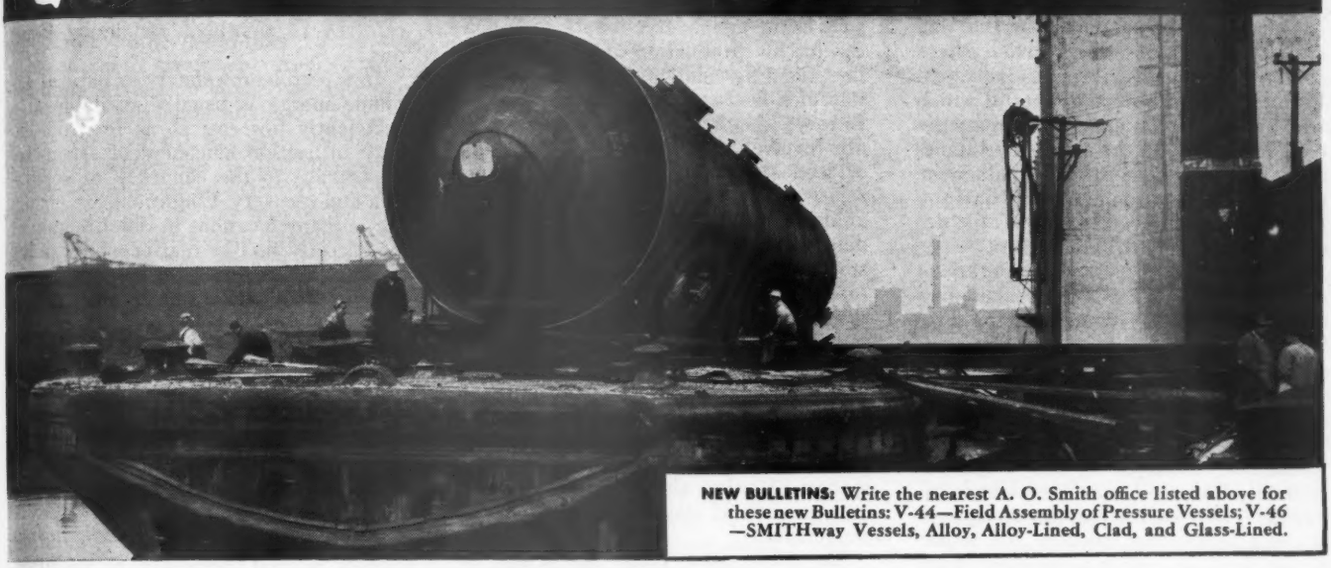

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BY WATER AND RAIL, A. O. Smith ships pressure vessels for the petroleum, paper, and process industries. The SMITH-lined Fractionating Tower above, one of the largest shop-fabricated vessels ever built (16 ft. diameter by 116 ft. long, weighing over 320,000 lbs.), is going by barge to an oil refinery in the Chicago area.

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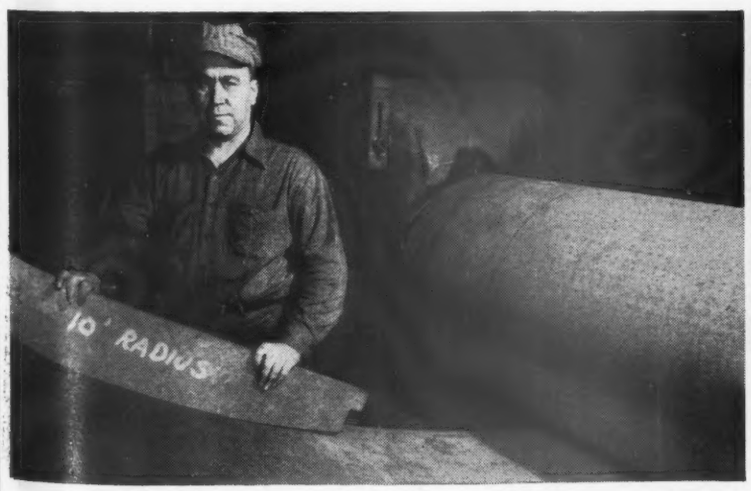

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am conditions in a pilot flashing unit, with analyses of the distillates and residues, is always required in the design of crude distillation units, regardless of how much back log of similar data may be available, or how reliable the empirical equilibrium flash vaporization correlations may be. This is particularly true where lube distillate production is involved. Neither empirical nor component methods are adequate in the wax and asphalt regions. Many articles have presented atmospheric pressure equilibrium flash vaporization data of which two by the writer are included in the references 3, 4. In the article by Edmister & Pollock[3] high pressure data were presented and complete correlations were developed. Kraft[6] discusses the design of vacuum distillation units.

Pilot and commercial plant operations might be used in developing method of applying the idea represented by Fig. 55 (Part 14) to design. Performance data could be used to define an actual operation and/or design case between the separation limits as defined by Fig. 55.

Another example of the empirical method of design was described by Packie[8], who correlated the sharpness of separation, the number of actual plates, and the reflux ratio using data from refinery fractionation units in developing the correlation. This correlation is easy to apply, and would be a worthwhile tool if results from applying it inspired confidence in the correlation, which is not this author's experience. It appears that it is too simple to take into account all the variables. One possible explanation for these results is the fact that Engler distillations are not very reproducible making inconsistencies in these characterizing analyses reflecting large discrepancies in the correlation itself.

This is a problem with all empirical methods, however. It emphasizes the desirability of developing an improved method of analyzing and characterizing mixtures. In sharply fractionated separations, the ASTM (or Engler) distillation curves of the adjacent products will have a gap between the end point of the lighter and the initial of the next higher boiling fraction. This results from the fact that the Engler distillation is partially differential. The T.B.P. distillation curve, on the other hand, is carried out with a high reflux ratio and with adequate contacting surface so that components present come off in the order of their boiling point. When fractional distillation products are analyzed by the T.B.P. distillation method, they show an overlapping as would be expected because adjacent products contain some of the same components as perfect separation is not possible. The thing that makes the ASTM distillation curves so unpredictable is the fact that they are carried out with an uncertain amount of reflux and with no contacting plates. If it were not for the heat loss and the human error, the ASTM would be a differential distillation curve and might be reproducible.

Hydrocarbon separation by absorption and/or fractional distillation may be computed by component or empirical methods with reasonable accuracy. For these separation processes, the design methods are sufficiently well developed and backed up by enough operating experience to permit making firm designs without requiring any pilot plant data, except in the case of special problems, such as the precise fractionation of naphtha for the production of aviation gasoline blending component or the preparation of a feed stock for making toluene. In cases like this such sharp separations are involved and such large quantities of feed stock are handled to obtain a relatively low yield that a very careful analysis of the feed stock is necessary to determine the composition of the feed stock. In addition it is frequently necessary to fractionate enough of the feed stock in the pilot plant laboratory to obtain a quantity of the desired product for anti-knock determinations or for experimental evaluation of the product as a starting material for a synthesis operation. If handled properly, this pilot scale feed preparation may also yield information of value about the reflux ratio and number of stages required for the separation.

For such pilot plant operations, a small bubble plate column should be used. This column should be flexible, continuous, adjustable, and well instrumented. It should be possible to vary the charge rate; the column should have resistance heaters distributed along the column to compensate for heat losses. With an apparatus of this kind it may be possible to obtain more data on a precise fractionation of a complex mixture in a shorter time, but probably at a higher cost, than could be calculated by the same number of men. In order for this data to be of any value in design, a method of scaling-up these results from the pilot plant to the commercial scale is needed.

THERMODYNAMIC EFFICIENCY

It is of interest to consider hydrocarbon separation operations from the standpoint of the thermodynamic efficiencies which necessarily involve entropy. In this connection the reader is referred to a valued article by Benedict[2].

In a petroleum refinery or natural gas plant, energy is usually available at a sufficiently low cost so as to make energy utilization efficiency of secondary importance to the efficiency of separation and recovery. Conditions are changing in many locations in the direction of more costly fuel so that economy is becoming more important. In considering the thermodynamic efficiency of hydrocarbon processes such as fractionation, absorption, etc., it is necessary to take into account the composition of the feed stock and the desired products and also the levels at which energy is supplied as heat and some as pumping or compressing power. In this discussion the attention will be devoted to hydrocarbon absorption and fractionation.

The energy added in a separation process is that necessary to maintain pressure and temperature conditions and the required interstage flows of liquid and vapor and also provide for the enthalpy leaving in the components. The addition of heat occurs at a high temperature level and the rejection of heat occurs at a low temperature. Thus heat flows through the process from the reboiler to the condenser. The work equivalent to these heat quantities is the difference in their entropies multiplied by the absolute temperature of the environment to which heat is being rejected; for example, the cooling water. This

FIG. 92. THERMODYNAMIC EFFICIENCY OF HYDROCARBON SEPARATION PROCESSES.

$$\text{Eff.} = \frac{\text{minimum work of separation}}{\text{total work and heat input}} = \frac{\Delta H - T_o \Delta S}{\Sigma W + T_o\left(\frac{Q''}{T''} - \frac{Q'}{T'}\right)}$$

ΔH = enthalpy of products—enthalpy of feed;
ΔS = entropy of products—entropy of feed;
T_o = base temperature, i.e. cooling water, air, etc.;
ΣW = summation of work added, i.e. compression, pumping, etc.;
Q' = heat added at Temperature T' in reboilers, preheaters, etc.;
Q'' = heat removed at temperature T'' in condensers, coolers, etc.

$$H \text{ (gas mixture)} = \Sigma x_i\left[\int C_{p^\circ} dT + H_o\right] - P_c \alpha_c \int \left[\alpha_R - T_R\left(\frac{\partial \alpha_R}{\partial T_R}\right)_{P_R}\right] dP_R$$

$$S \text{ (gas mixture)} = \Sigma x_i\left[\int \frac{C_{p^\circ}}{T} dT + S_o\right] - R\Sigma x_i \ln x_i - R \ln P - \frac{P_c \alpha_c}{T_c} \int -\left(\frac{\partial \alpha_R}{\partial T_R}\right)_{P_R} dP_R$$

Subscripts: i = any component; o = reference or base condition; c = pseudo-critical; R = reduced condition.

NOTE: Last term in both H and S equations evaluated for mixture as a whole from generalized thermodynamic functions.

energy goes into doing the work of separation with consequent losses due to the irreversibility of the process. The minimum work of separation is determined by the enthalpy and entropy changes in the components in going from feed to products and the absolute temperature of the environment. The minimum work for a given separation is a function of the feed stock and the products and independent of the process used. On the other hand the actual work required for a given separation is very definitely a function of the type and design of the separation process.

The ratio of the minimum to actual works of separation is the thermodynamic efficiency of a separation process. This definition of the thermodynamic efficiency is shown in equation shown on Fig. 92. It will be noted that both the numerator and the denominator contain a temperature term, which is the environment and is not to be confused with the reference temperatures used in computing enthalpies and entropies.

Also shown on Fig. 92 are equations for the enthalpy and the entropy of gaseous mixtures. It should be pointed out that the last term of each equation represents two things; namely, the isothermal pressure correction and the mixing effect of the components of the gas. Similar equations can be written for liquids and would include terms for mixing and for pressure effects. These equations are very complex and will not be presented here because of unnecessary complications.

The thermodynamic efficiency and the reversibility of a separation process are related and the degree of reversibility of a separation process indicates the extent to which the work may be made to approach the minimum required by thermodynamics to effect the separation. Benedict[2] classified multistage separation processes as *potentially reversible*, *partially reversible*, and *non reversible*.

A separation process is called *potentially reversible* when the work can theoretically be reduced to that required by thermodynamics. Fractional distillation is an example of potentially reversible process. A separation process is said to be *partially reversible* when most of its steps are potentially reversible but a few are irreversible. Absorption and extraction distillation are partially reversible processes. Considering countercurrent multistage hydrocarbon separating apparatus such as absorbers and fractionators from a standpoint of thermodynamics, the following observations can be made:

Absorption is not a potentially reversible process because the entering lean oil is not in equilibrium with the exit gas.

Absorption would be a potentially reversible process if the lean oil contained enough of the light components to make it in equilibrium with the exit gas. As practiced, therefore, absorption is not reversible and the composition of the exit gas and the pressure are not sufficient to fix the temperature. The thermodynamic efficiencies of such a process are low because of the amount of energy that must be supplied in the stripper to strip the lean oil.

Fractional distillation is a potentially reversible process with the tops and bottoms in equilibrium with the phases which they lift. The thermodynamic efficiency of this process, which is highest of all separation processes, can be increased by adding heat incrementally to each tray in the stripping section and removing heat incrementally from each tray in the enriching section. Such a procedure would be of interest only where there is a use for the heat removed and where heat is available more cheaply at lower temperatures than at the reboiler temperature.

The thermodynamic efficiency of a fractionator can be very useful in determining the proper design to use for a given separation. This is the limiting efficiency that can be approached in design and should be of considerable interest.

Narrow boiling feed stocks have smaller difference between the reboiler and the condenser temperatures so that the levels at which heat is supplied and rejected are not very far apart. However, to offset this, the narrow boiling feed stocks require more reflux to separate them. These two effects are compensating so that the result is that the thermodynamic efficiency is principally a function of the feed composition and the desired sharpness of cut.

Fig. 4 in Part 1 shows a fractionator as a series of equilibrium flash vaporization stages with the interstage flows of vapor and liquid indicated. In a process such as this, it is customary to add the heat all at the reboiler and reject all the low grade energy at the condenser. This case of operation is referred to as Case I in the heat graph of Fig. 4. The same interstage flows and the same temperature gradient could be maintained by adding heat at each stage in the stripping section. In this way the heat would be supplied at different temperature levels and likewise, rejected at different temperature levels. In some cases this might be an advantage commercially. From a theoretical point of view, Case II has a higher thermodynamic efficiency.

In computing the entropies and enthalpies of the feed and products for the evaluation of the minimum work of separation and the thermodynamic efficiency, as defined on Fig. 92, it is imperative that the reference point be the same for all components or streams so that all values will be consistent. Where both phases are involved as would be if the feed is in the liquid phase, the overhead in the vapor phase, and the bottoms in the liquid, the entropy and enthalpy evaluations could refer to the conditions of one of the streams, such as the feed or the overhead, etc. The customary reference state is vapor at zero pressure and a standard temperature of say, 25 deg C, or saturated liquid at some low temperature. The objection to the latter is that it is difficult if not imposible to use it generally without confusion because of the wide spread of boiling points and vapor pressures for hydrocarbons.

Referring to Fig. 92, the equation for the enthalpies of a gaseous mixture involves two terms; the first term is the summation of the individual enthalpies for the components and the second term is the isothermal pressure correction which is evaluated for the mixture as a whole. The reference point is zero pressure and any low convenient temperature. The equation for the entropies of a gaseous mixture involves four terms; the first two terms being summation terms. The first term is the summation of the individual entropies of the components in the mixture, the second term gives the entropies of mixing, while the third term gives the ideal gas isothermal pressure correction, and the last term gives the isothermal pressure correction that is necessary because of deviation for the ideal gas law. The last term in each of these two equations would be zero for an ideal gas. These terms may be evaluated from the generalized thermodynamic properties of hydrocarbons developed by this author. (See thermodynamics series in *Petroleum Refiner.)*

It is frequently preferable to consider the thermodynamic efficiency of the entire separation plant, including compressors and other auxiliaries rather than computing it just for the fractionation tower alone. In this way all the pumping and compressing work may be included in the balance. Including all the facilities of a given hydrocarbon separation plant in the calculations of the thermodynamic efficiency permits evaluating alternate flow schemes. Where there are two towers operating in series for the separation of narrow boiling hydrocarbon fractions it is sometimes possible to use the heat removed from the condenser of the first tower to reboil the second tower. This improves the thermodynamic efficiency of the entire system.

REFERENCES

1. Bell, F. W., "Increasing Propane Recovery in Existing Natural Gasoline Plants." *Petroleum Refiner. 24*, 115 (June, 1945).
2. Benedict, M., "Multistage Separation Processes." *Chem. Eng. Prog. 43*, 41-60 (1947).
3. Edmister, W. C., and Pollock, D. H., "Phase Relations for Petroleum Fractions." *Chem. Eng. Prog.* December, 1948.
4. Edmister, W. C., Reidel, J. C., and Merwin, W. J., "Equilibrium Flash Vaporization of Three Petroleum Fractions." *Trans. Am. Inst. Chem. Engrs. 39*, 457 (1943).
5. Heath, R. W., Taylor, J. B., Jr., and Hill, P. W., "Practical Refrigeration for Natural Gasoline Plants." *Petroleum Engineer.* P. 162 (May, 1946).
6. Kraft, W. W., "Vacuum Distillation of Petroleum Residues." *Ind. Eng. Chem. 40*, 807 (May, 1948).
7. Laverty, F. W., and Edmister, W. C., "Liquefaction and Regasification of Lighter Hydrocarbons." *Oil & Gas Journal.* September, 1941.
8. Packie, J. W., "Distillation Equipment in the Oil Refining Industry." *Trans. Am. Inst. Chem. Engrs. 37*, 51 (1941).
9. Ragatz, E. G., and Richardson, J. A., "Evaluation of Absorber Operating Efficiency." *California Oil World*, second issue, October, 1946.
10. Ragatz, E. G., "Straight-Line Chart Determination of Absorber Extraction Efficiency." Presented on Joint Meeting of California National Gasoline Association and Southern California Section of A.I.Ch.E., December 10, 1947. Published as *Clark Bros. Bulletin*, 1948.

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What single factor has done the most to bring economical, profitable operation within the reach of all refiners?

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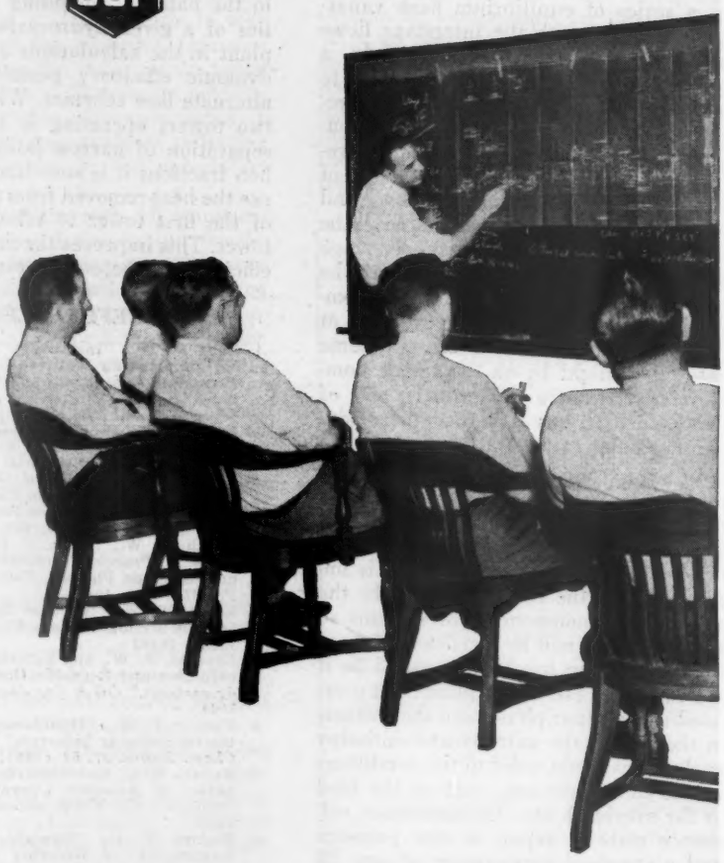
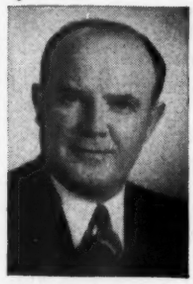


Converted War Refinery Gives Sunray 20,000 b/d

By F. L. Martin
Executive Vice-President
Sunray Oil Corporation

THE Sunray refinery near Duncan, Okla., is currently processing approximately 20,000 barrels of Oklahoma crude every day to produce a wide range of readily marketable products—not 100-octane gasoline for which the plant was originally designed.



F. L. Martin

Built and operated during the war by Associated Refineries, this plant had been producing about 250,000 barrels of aviation gasoline a month. When it was shut down at the close of the war, doubt existed generally that it could be operated profitably under peacetime conditions.

Purchased in 1947

After consultation with the refinery's designers, Universal Oil Products Co., we decided to negotiate its purchase which was completed in October 1947. Conversion to commercial operation, making the greatest possible use of existing facilities, was begun at once under Universal's direction.

This is what we had purchased: a two-stage fluid catalytic cracking plant with a charging capacity of 12,000 barrels of fresh feed per day; a gas concentration system; a hydrogen fluoride alkylation unit which produced 2,500 barrels per day of alkylate; an isomerization plant capable of producing 300 barrels per day of isobutane; and a modern boiler plant.

Auxiliary equipment included three large forced-draft cooling towers necessitated by the heavy water requirements of the alkylation plant. Tankage included rundown, charging stock and product storage tanks. There were, as well, buildings and shops and a large loading dock.

An adequate supply of crude was at hand from the nearby Velma field and low cost electricity and natural gas were available.

Objections to Overcome

Our new refinery possessed no pipe lines to afford economical transportation for crude coming in and product going out, inasmuch as it had been designed to operate exclusively on gas oil delivered by truck, and to produce aviation gasoline shipped by tank car.

The wartime equipment included no topping unit, an essential requirement for a refinery running crude oil. There was no desalting equipment, needed in treating Velma crude. A vacuum

(Advertisement)

unit was lacking for the recovery of heavy, waxy gas oil from topped crude. A vis-breaking operation would be required to make a salable fuel oil from the heavy residue. There was no provision for treating the products of crude distillation.

Changes Called For

Our original Sunray refinery with a capacity of 12,000 barrels per day is located at Allen, Okla., some 100 miles from Duncan by pipe line route. One of the first requirements was to connect the two refineries for product exchange and storage. At the same time, a short line was needed to bring crude from the Velma field to Duncan.

As operated in wartime, the light gases from the cat cracker were charged to the alkylation unit to produce aviation alkylate. Since that procedure was not applicable to our new operating schedule, it was desirable to install a polymerization unit and a propane separation unit to prepare this product for the LPG market.

We decided to operate the cat cracker as a single stage unit and extensive changes in both the reactor and regenerator sections were necessary. The large feed heater, no longer required, and the retreat fractionating column, were taken as basic elements for a new topping unit.

In order to increase the crude capacity of the converted plant it was decided to preflash the crude. A heat exchanger from the alkylation unit and the debutanizer tower from the gas concentration system were combined into a preflashing unit. Thus, about 15 percent of light straight run gasoline is flashed off when the charge to the crude unit is preheated to about 400°F. This improvised crude unit and the preflashing system give the plant its 20,000 b/d crude capacity.

A large settler from the alkylation unit was converted into a vacuum unit; a poly unit was built to handle the gases from the crude unit and the cat cracker; a propane unit was installed. In all these, existing equipment was utilized to a great extent.

Profitable Operation

Actual construction began in October 1947, and 90 days later the topping operations were processing 18,000 bbls. per day. On April first the vacuum vis-breaking operation started producing feed stock for the catalytic cracker, and on June first the catalytic cracker was on stream.

The cooperation received from Universal Oil Products Co. completely changed the plant from a wartime operation to a practical commercial refinery within nine months, including 98 miles of six-inch products pipe line construction.

This conversion at Duncan has resulted in a very successful and profitable operation for Sunray, and at the same time has balanced refinery run to crude oil production.

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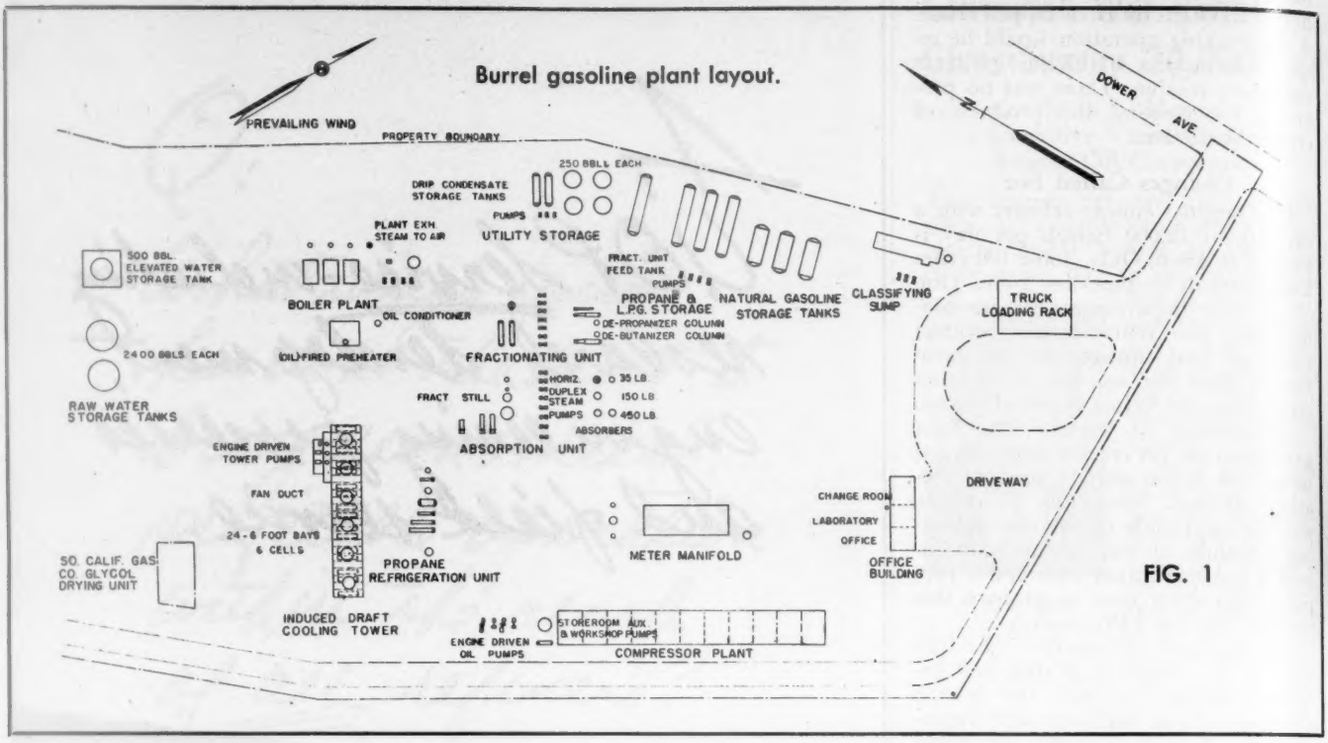


Burrel gasoline plant layout.

FIG. 1

High LPG Recovery at New California Plant

M. E. GARRISON*

PART 1

A NATURAL gasoline plant which has achieved an 80 per cent extraction level of propane potential and a 90 per cent of isobutane potential has been operated by the General Petroleum Corporation in the Fresno area of California since April, 1946.

This high extraction efficiency has been particularly desirable since the demand for propane in the area where the plant is located has been growing at a remarkable rate.

Notable in the design and construction of the plant, which is designated by General Petroleum as the "Burrel Gasoline Plant," is the unique plant gathering system which is believed to be the largest ever installed in a natural gasoline plant in California.

Size and Purpose

The plant was designed with a capacity of 30,000,000 cu ft per day of wet gas which was found to be available in the field at three pressure levels: 50 psig, 150 psig, and 450 psig.

Purposes of the plant are: (1) to deliver dry gas at 440 psig pressure to a gas company; (2) to deliver dry gas at from 500 to 600 psig to another gas company pipe line system at a controlled maximum temperature 5 degrees above wet bulb, and a minimum temperature of 60 F; (3) to make possible the extraction and retention of 85 per cent of the isobutane content of the wet gas, and at the same time extract up to 70 per cent of the propane content of the wet gas.

The actual extraction in the 35 months the plant has been in operation has exceeded 80 per cent of propane potential and 95 per cent of the isobutane.

A fourth aim of the designers was to make possible selective absorption within the absorption plant to a point where extraction efficiency can be controlled with a minimum quantity of recycled gas and with minimum plant fuel consumption.

To accomplish this it was calculated that the most economical main absorption pressure would be 450 psig.

The approximate average isobutane-plus-gasoline content of the combined wet gas was 1.3 gpm and the 20 per cent rectified content 0.6 gpm.

Gathering System

Three areas are available from which the wet gas had to be collected, namely, the Helm field, the Lanare field, and the Riverdale field. The Helm field lies northwest from the gasoline plant; the Lanare field lies south of the gasoline plant; and the Riverdale field lies south and east from the gasoline plant.

From the Helm field a high pressure wet gas gathering line has been laid to the plant, approximately 8 miles in length, to deliver wet gas at from 440 to 450 psig at the gasoline plant. A low pressure wet gas line parallels the high pressure wet gas line to deliver wet gas at the plant at 50 psig. This permits two-stage gas trap operation for the separation of

*Project Engineer, General Petroleum Corporation.

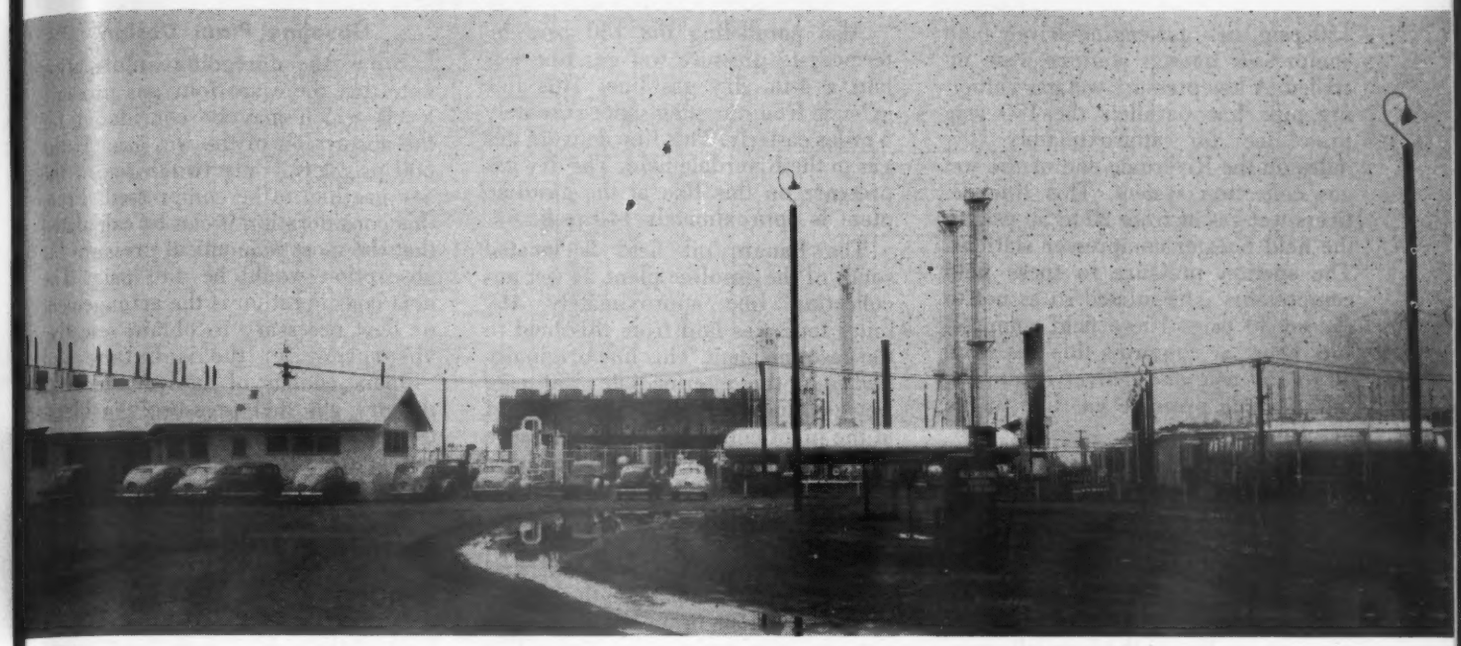


FIG. 2. View of General Petroleum Corporation's natural gasoline plant looking north.

the oil and gas as it flows from the producing well. In general all of the wet gas lines are laid to grade sloping towards the gasoline plant. The 50 psig wet gas line carries the condensate for both lines through two sets of drip stations located in the field, and one set located at the entrance to the gasoline plant. Vertical drip pots were installed with level and pressure controls in order to raise the condensate to successively higher elevation.

On the 450 psig gas line, three Torrance heater installations have been installed to minimize the possibility of the formation of hydrates during the winter months. These are designed to maintain the gas temperature above 60 F. These heater installations are of the circulating hot water type and are automatic in operation, requiring very little operating attention. The element for heating the wet gas consists of a pipe jacket installed around the outside of the main gas line through which hot water from the Torrance heater is circulated by means of a motor driven pump. For the 10-in. line this jacket was installed 80 ft in length, and for the 6-in. line size the jacket was 60 ft in length. A flanged expansion joint was installed in the center of each jacket pipe to permit unequal expansion between jacket and main gas line.

A 4-in. dry gas line parallels the Helm wet gas gathering line for approximately 3¼ miles west from the gasoline plant, where it ties to the Amerada Petroleum and to the General Petroleum Corporation dry gas fuel systems. The dry gas pressure on this line is approximately 140 psig.

Between the gasoline plant and the Helm field a large irrigation channel, approximately 125 ft wide, had to be crossed. A pipe line suspension bridge was installed over this channel.

From the Riverdale oil field was laid an intermediate pressure wet gas gathering line approximately 7½ miles long, to deliver gas at from 145 to 160 psig at the gasoline plant. To collect the low pressure wet gas below

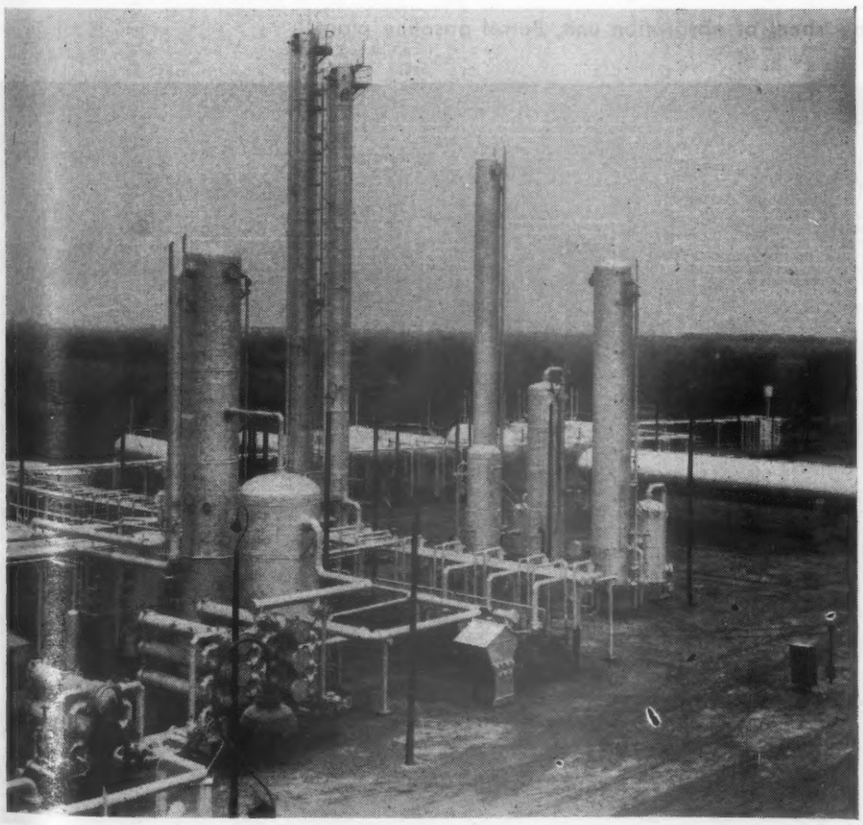


FIG. 3. Stripping, fractionating, absorbing, and storage equipment at Burrel plant.

150 psig, two gas-engine-driven field compressor booster stations were installed. A low pressure wet gas gathering pipe line parallels the 150 psig pipe line for approximately 2¾ miles on the Riverdale end of the wet gas collection system. This line delivers wet gas at from 20 to 50 psig to the field booster compressor stations. The suction pressure to these field compressors is regulated so as not to exceed 30 psig. These field compressors boost or compress this gas from 30 to 150 psig and deliver it into the intermediate pressure gas line to the gasoline plant.

Two additional field compressor stations were later installed. One of these compresses wet gas and tank vapors from 5-in. vacuum to 150 psig and the other compresses tank vapors from 5 in. to 10 in. vacuum and delivers them into the 30 psig low pressure wet gas line to the formerly mentioned field booster compressors.

In general the 150 psig intermediate pressure wet gas line slopes towards the gasoline plant and the low pressure wet gas line slopes towards the field booster compressor stations. Vertical drip pot installations are located at each field compressor station in conjunction with intake wet gas scrubbers. These vertical drip pot installations are also located at the Murphy Slough crossing and at the entrance to the gasoline plant.

Also paralleling the 150 psig intermediate pressure wet gas line was laid a 4-in. dry gas line. This line extends from the plant approximately 5 miles easterly. This line delivers dry gas to the Riverdale field. The dry gas pressure on this line at the gasoline plant is approximately 140 psig.

The Lanare oil field is located south of the gasoline plant. A wet gas collection line approximately 4½ miles long was laid from this field to the gasoline plant. This line originally tied into the intermediate 150 psig wet gas line from the Riverdale field at the plant entrance. Due to pressure decline in this field this line was later connected into the 50 psig wet gas line from the Helm field at the gasoline plant west property boundary.

In general the wet gas gathering system, due to the long lengths of pipe line involved in order to collect the wet gas, was designed so that when future pressure declines had to be met, field booster compressors would be installed in order to maintain sufficient pressure and capacity.

The field booster compressor units consist of Waukesha 6 WAKU 90 hp gas engines V-belt driving second-hand type XRB heavy duty Ingersoll-Rand twin-cylinder compressor units. A thermo-syphon oil-compressor jacket cooling system with a vertical surge tank was installed for cooling the compressor jackets.

Gasoline Plant Design

From the foregoing information note that there are four gas pressure levels which may be considered for the absorption of the wet gas. At the 600 psig level only two-thirds of the dry gas had to be compressed. From this consideration it can be calculated that the most economical pressure for absorption would be 450 psig. The next consideration is the arrangement or flow necessary to obtain selective absorption for the isobutane and propane content of the wet gas. Also the dry gas fuel pressure considerations enter into the calculations at this point; 150 psig pressure was decided to be the most desirable fuel gas pressure for delivery to the field. On this basis a flow sheet was arranged and the general oil and gas flow for the absorption system is shown by Fig. 4.

It is to be noted that at the 150 psig level all the rich oil from the 450 psig absorber is flashed in the base of the 150 psig absorber. Additional wet gas is added to the 150 psig absorber as required to furnish field fuel and plant fuel make-up. In addition in order to make maximum propane yield the depropanizer vent gas vapors and the depropanizer feed tank vapor are returned to the 150 psig absorber.

The rich oil then flows from the base of the 150 psig absorber through heat exchangers, where it can be

FIG. 4. Flow sheet of absorption unit, Burrel gasoline plant.

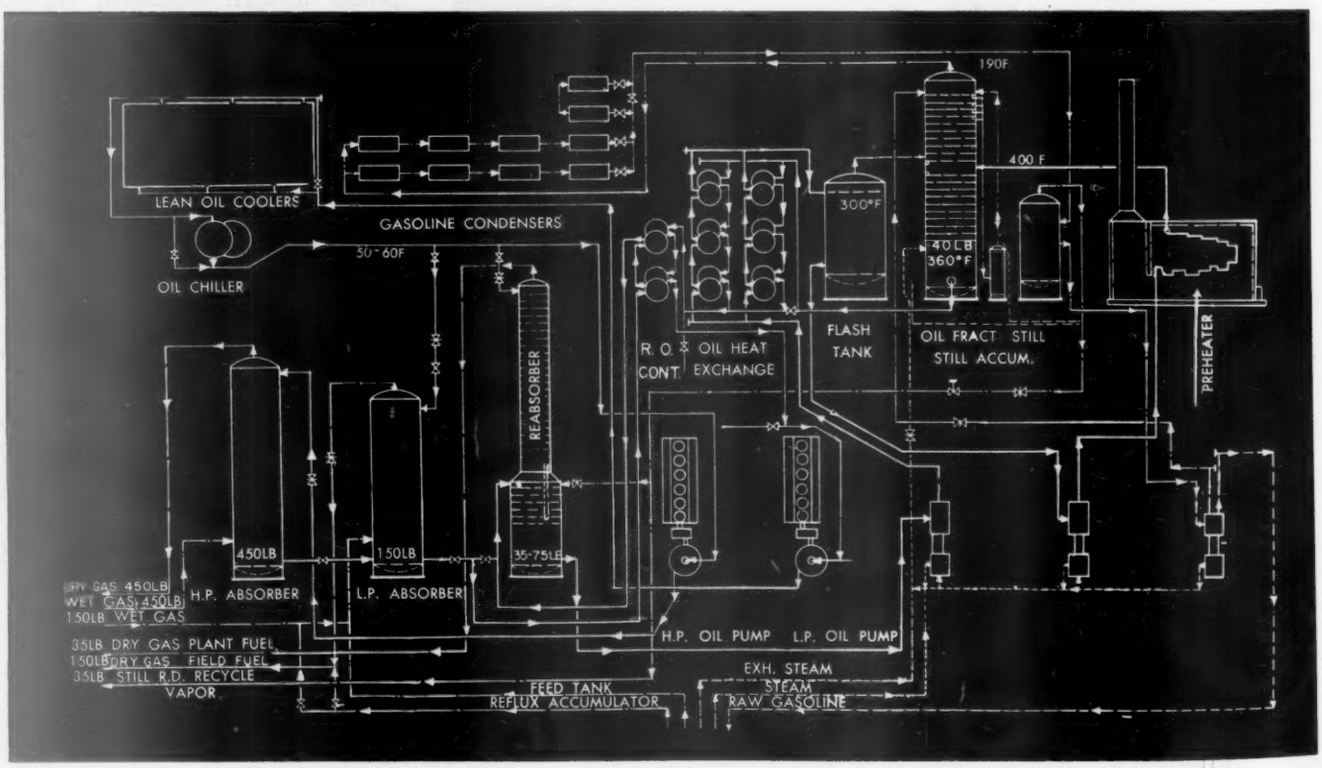


TABLE 1. BURREL GASOLINE PLANT—MATERIAL PROCESS FLOW CALCULATIONS.

Columns	1	2	3 (1 plus 2)	4	5	6	7	8	9	10	11	12	13 (9 plus 12)	14	15	16	17 (13 minus 19)	18	19	20
			COMPOSITE Gas 21,000 MCF 450 lb.		Cooling gas 65°F—450 lb. L+V —3.75 + 96.25 Comp				COMPOSITE GAS Residue Gas After Cooling		450 lb. Gas to absorber				450 lb Absorber Analysis—30,000 MCF—Lean Oil 38° API Grav.—185 Molecular Weight—14.3 Vapor Equiv.—60° F Lean Oil—95° F Rich Oil						
					Liquid						Helm Field Wet Gas Added		COMPOSITE wet Gas at 450 lb		DRY GAS TO SALES			Rich Oil Composition		
Component Material	50 lb. Helm wet gas 8,000 MCF Mol %	150 lb. Riverdale wet Gas 13,000 MCF Mol %	Mol %	MCF	Mol %	MCF	Cu Ft. /Gal.	Gal.	MCF	Mol %	Mol %	MCF	MCF	Mol %	Component	Mol%	MCF	Gallons	Mol%	MCF	Gallons
CO_2	0.32	0.63																		
Methane	88.62	73.86	78.10	16,401.0	10.68	84.0	59.0	1,422	16,317.0	80.75	90.26	8,835.0	25,152.0	83.87	Methane	89.7	24,477.0		7.4	675.0	11,440
Ethane	5.76	10.12	8.46	1,776.6	8.01	63.0	42.0	1,500	1,713.6	8.56	4.32	422.0	2,135.6	7.11	Ethane	6.7	1,838.6		3.2	297.0	7,080
Propane	5.20	7.75	6.78	1,423.8	15.46	121.8	36.45	3,345	1,302.0	6.34	2.91	285.5	1,587.5	5.29	Propane	3.5	952.5	26,100	7.0	635.0	17,900
Isobutane	1.33	1.87	1.66	348.6	6.94	54.6	30.65	1.780	294.0	1.45	0.73	71.5	365.5	1.21	Isobutane	0.1	21.9	715	3.7	343.6	11,200
Butane	1.97	3.52	2.92	613.2	16.51	130.2	31.79	4.200	483.0	2.39	1.02	100.0	583.0	1.94	Butane		9.0	283	6.3	574.0	18,050
C_5 Residue	1.80	2.25	2.08	436.8	42.40	333.9	27.67	12.050	102.9	0.51	0.76	73.5	176.4	0.58	C_5Residue			283	1.9	175.4	6,380
TOTALS	100.00	100.00	100.00	21,000.0	100.00	787.5	Av 30	26,297	20,212.5	100.00	100.00	9,787.5	30,000.0	100.00	TOTALS	100.0	27,299.0		29.5	2,701.0	72,050
															Abs. Oil				70.5	6,435.0	
															TOTAL				100.0	9,136.0	

NOTE:*
All computations in table based upon an isobutane absorption factor—1.3
Overall extraction efficiency of isobutane to be 92 per cent or better.
Absorber design to permit increasing oil rate to yield 70 per cent propane recovery, and retention if possible.
All calculations are slide rule accuracy.

Calculation based upon 8 theoretica plates and 96 per cent Isobutane absorbed.

Lean oil—312 gpm Equilibrium at 70F—306,400 lb. absorbed—54,080 M Btus absorbed. OIL GAS RATIO—Lean oil to dry gas 16.45/ MCF.

Note: Using a Propane Abs. Factor 0.8 and 60 F Oil equals 76% Propane absorbed-L.O. 396 gpm.

Columns	21	22	32	33	41	42	43	44	3	45	23 (22 plux 33 plus 42, 44 and 45)	24
	150 lb. Wet Gas Summation to 150 psig Fuel Gas Absorber										150 lb.	
	450 lb. Oil Flash 95°F L/V- 96.2+3.8		450 lb. Cond. Flash		Depropanizer Vent Gas		Raw Gaso. R.D. 150 lb Vent Gas		150 lb. Wet Gas Make-up Fuel Req.		Total COMPOSITE Wet Gas to 150 lb Abs.	
Component Material	Liquid MCF	Gas MCF	Mol%	MCF	Mol%	MCF	Mol%	MCF	Mol%	MCF	Mol%	MCF
Methane	401.5	273.5	54.1	61.8	10.1	39.6	42.2	3.8	78.10	1,562.0	67.9	1,940.7
Ethane	263.8	33.2	18.6	21.3	32.3	126.0	17.8	1.6	8.46	169.2	12.3	351.3
Propane	609.5	25.5	15.5	17.7	57.6	225.0	22.2	2.0	6.78	135.6	14.2	405.8
Isobutane	337.3	6.3	3.4	3.9			7.8	0.7	1.66	33.2	1.5	44.1
Butane	565.8	8.2	6.6	7.5			8.9	0.8	2.92	58.4	2.6	74.9
C_5 Residue	176.1	0.3	1.8	2.1			1.1	0.1	2.08	41.6	1.5	44.1
TOTALS	2,354.0	374.0	100.0	114.3	100.0	390.6	100.0	9.0	100.00	2,000.0	100.0	2,860.9
Abs. Oil	6,435.0	(92° after flash) Assumed Composition for Depropanizer Wet Gas										
TOTAL	8,789.0											

Total Wet Gas 32,000 MCF Potential in Wet Gas		
Component	MCF	Gallons
Propane	1,844.9	50,650
Isobutane	453.3	14,800
Butane	771.6	24,250
C_5Residue	551.9	19,800
TOTALS	3,621.7	109,500

Note: Approximately 6000 gallons Propane recirculation

Potential in Dry Gas from Absorbers			
Component	MCF	Gallons	% Loss
Propane	1,431.1	39,130	77.2%
Isobutane	31.4	1,025	6.9%
Butane	14.0	440	1.8%
TOTALS		40,595	

(Minimum Propane recovery Most economical Isobutane recovery)

Columns	25	26 (24—28)	27	28	29 (21 plus 28)	30	31	37	38	39	40	41	42
	Absorber Analysis Dry Gas 2,466.9 MCF Lean Oil 38° API Grav.—185 Mol Wt. Vap. Eq.—14.3 Oil in 60°F—Rich Oil 75°F Composite 90°F							RICH OIL FLASH in base of 35 psig Absorber					
	DRY GAS FUEL			Absorb.	COMPOSITE Rich Oil			At 160°F				At 120°F	
								Liquid		Gas—Wet		Gas—Wet	
	Mol %	MCF	Gallons	MCF	MCF	Mol %	Gals.	Mol %	MCF	Mol %	MCF	Mol %	MCF
	77.2	1,903.2		37.5	439.0	4.27	7,440	0.4	36.5	30.3	402.5	39.9	386.0
	12.5	309.1		42.2	306.0	2.97	7,280	0.9	76.5	17.3	229.5	18.6	180.0
	10.1	249.6	6,850	156.2	765.7	7.44	21,600	4.4	396.7	27.8	369.0	24.6	238.0
	0.1	3.5	114	40.6	377.9	3.67	12,310	2.9	260.4	8.9	117.5	6.4	62.0
	0.1	1.5	47	73.4	639.2	6.21	20,050	5.3	471.2	12.7	168.0	9.0	86.5
				44.1	220.2	2.13	9,045	2.3	206.7	1.0	13.5	0.4	4.0
	100.0	2,466.9	7.011	394.0	2,748.0	26.69	77,725	16.2	1,448.0		1,300.0		956.5
Abs. Oil				1,117.0	7,551.0	73.31		83.8	7,522.0	2.0	29.0	1.1	11.0
TOTALS				1,511.0	10,299.0	100.00		100.0	8,970.0	100.0	1,329.0	100.0	967.5

Lean Oil 54 gpm.—Total lean oil 366 gpm.—Total Rich oil 419 gpm.
Oil Gas Ratio—Lean Oil to Dry Gas—31.6 gal/MCF Equilibrium taken on 5 theoretical plates. This is based on using a 17-plate absorber on hand. Isobutane Absorption Factor 1.3—Temp 70°F.

With a Propane factor of 0.9 and using 60°F Lean Oil and equilibrium on 5 theoretical plates calculates a 92 per cent propane recovery. This requires a 92 gpm lean oil circulation rate. Oil Gas Ratio based on 92 gpm calculates to be 54 gals per MCF.

heated to from 120 F to 180 F temperature as desired. The heating medium is hot lean oil from the still (Fig. 4.) The hot rich oil passes from these heat exchangers into the base of a 35 psig reabsorber, where it is flashed. Selective absorption is made possible by the control of the oil gas ratios on the 450 psig, 150 psig and 35 psig absorbers and by the control of the rich oil temperature to the 35 psig absorber. In order to accomplish this control, it can be observed (Fig. 4,) that the raw gasoline still vapors are compressed from 30-35 psig to 150-160 psig and the raw gasoline make, excess above reflux, is pumped into these compressed vapors in the coolers in the cooling tower on their way to the depropanizer feed tank. This flow eliminates the recycle vapor build-up commonly found in the older plants in operation in California.

Further consideration in the design at this point was, the desirability of chilling the lean oil and wet gas, because of the temperature specification for residue dry gas sales at from 60 F to 70 F both during the summer and winter months. At this point however we are only interested in the fact that oil and gas temperatures may be selected for design regardless of seasonal atmospheric cooling conditions.

In order to design properly for the flow sheet indicated in Fig. 4, an assumption of the gas quantities to be handled had to be made from field data. Also a composite analysis of the wet gas had to be obtained from very preliminary laboratory data. Material balances and equilibria were next calculated so the equipment could be selected properly for installation. These data can be observed in Tables 1 and 2.† In addition, in Fig. 6† is plotted the daily volume of methane, ethane, and propane vented at temperatures from 120 F to 180 F for a 1.3 isobutane absorption factor throughout the three absorption steps. From these data it can be observed that the optimum temperature for the extraction of isobutane is in the neighborhood of 160 F. Also it can be observed that for maximum propane extraction the temperature should be in the neighborhood of 120 F. These temperatures refer to the flash temperature of the rich oil in the base of the 35 psig reabsorber. However, the propane extraction is dependent on the lean oil temperature to the absorbers and the oil gas ratio selected which sums up into the selection of a proper propane factor for the most economical recovery. In Fig. 7† are plotted curves of different lean oil temperatures with reabsorber flash temperatures plotted as ordinates and oil gas ratio requirements plotted as abscissas.

It is to be noted that the elimination of the light hydrocarbon fractions of methane, ethane and propane, from the rich oil in the 35 psig reabsorber eliminates these vapors from contamination in the raw gasoline and performs the function of partial deethanization by means of selective absorption. These light fractions once condensed in the raw gasoline stream, in the past, led to high recycle loads and considerable recompression in order to prevent gasoline losses. The method used in the design of the Burrel gasoline plant minimizes these vapors from the rich oil at the expense of only a small amount of additional oil circulation rate.

The data in Tables 1 and 2,† and the proposed flow sheet Fig. 4 make it possible to design all the equipment in the absorption circuit. The selection of gas engine and steam driven pump equipment was tied in with a utilization study of the exhaust steam usage possible; i.e., still agitation, depropanizer and debutanizer reboilers and for feed-water heat.

From a study of the absorption flow sheet (Fig. 4) note that excess exchange surface needs to be provided in order to provide rich oil temperature control to the reabsorber, and to provide as high a flash tank temperature as possible. The higher the flash tank temperature the lower will be the heat load required by the fired-type preheater permitting a greater load capacity variation for the entire system.

The flash tank was made large enough to provide surge capacity for the entire distillation system. The fired-type preheater feed pumps take suction on the rich oil flash tank and are controlled by the fractionating still level control. The rich oil from the base of the reabsorber is pumped through the heat exchangers to the rich oil flash tank and are controlled by the level control installed on the base of the reabsorber.

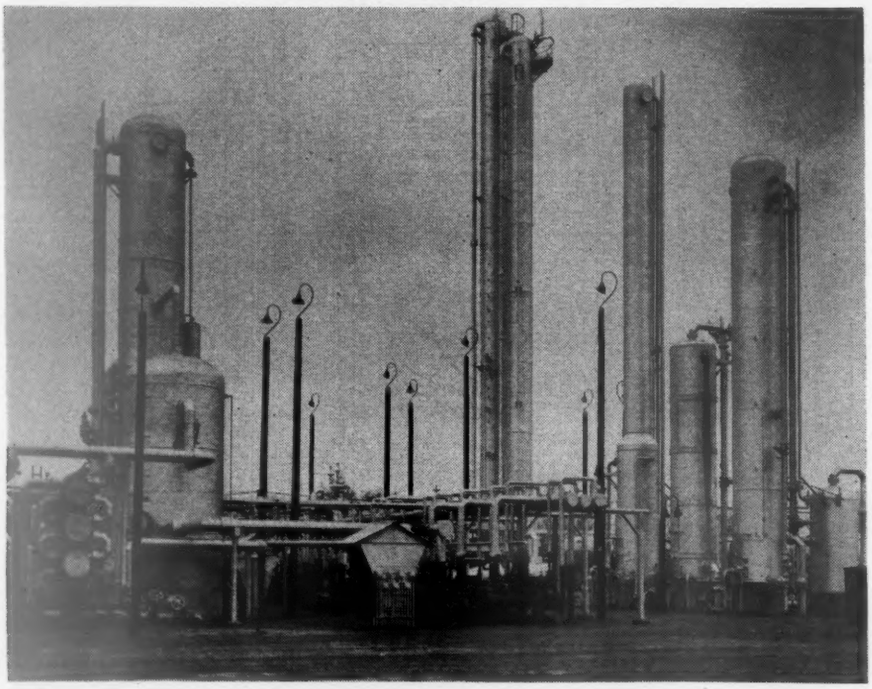
The 450 psig absorber and the 35 psig reabsorber have fixed rate controllers installed on the lean oil lines to them. The 150 psig absorber has a lean oil gas ratio controller installed, since the gas volume fluctuates to this absorber depending upon the dry gas fuel demand.

It is to be noted that the still vapors are connected into the reabsorber as well as to the recycle compressor, so that when the compressor shuts down for any purpose these vapors are not lost to air and have an emergency place to go. For this reason it has been found desirable to operate the still pressure some 5 to 10 psi higher than the reabsorber pressure. * * *

Mr. Garrison's article in its entirety will be published in three parts. Because of the importance of the subject it was believed that condensation of the study is not desirable.

†Table 2 and Figs. 6 and 7 will be found in Part 2, to be published soon.

FIG. 5. Process equipment with heat exchangers, distillation columns, pumps, fractionating columns, and absorbers, from left to right, at General plant.



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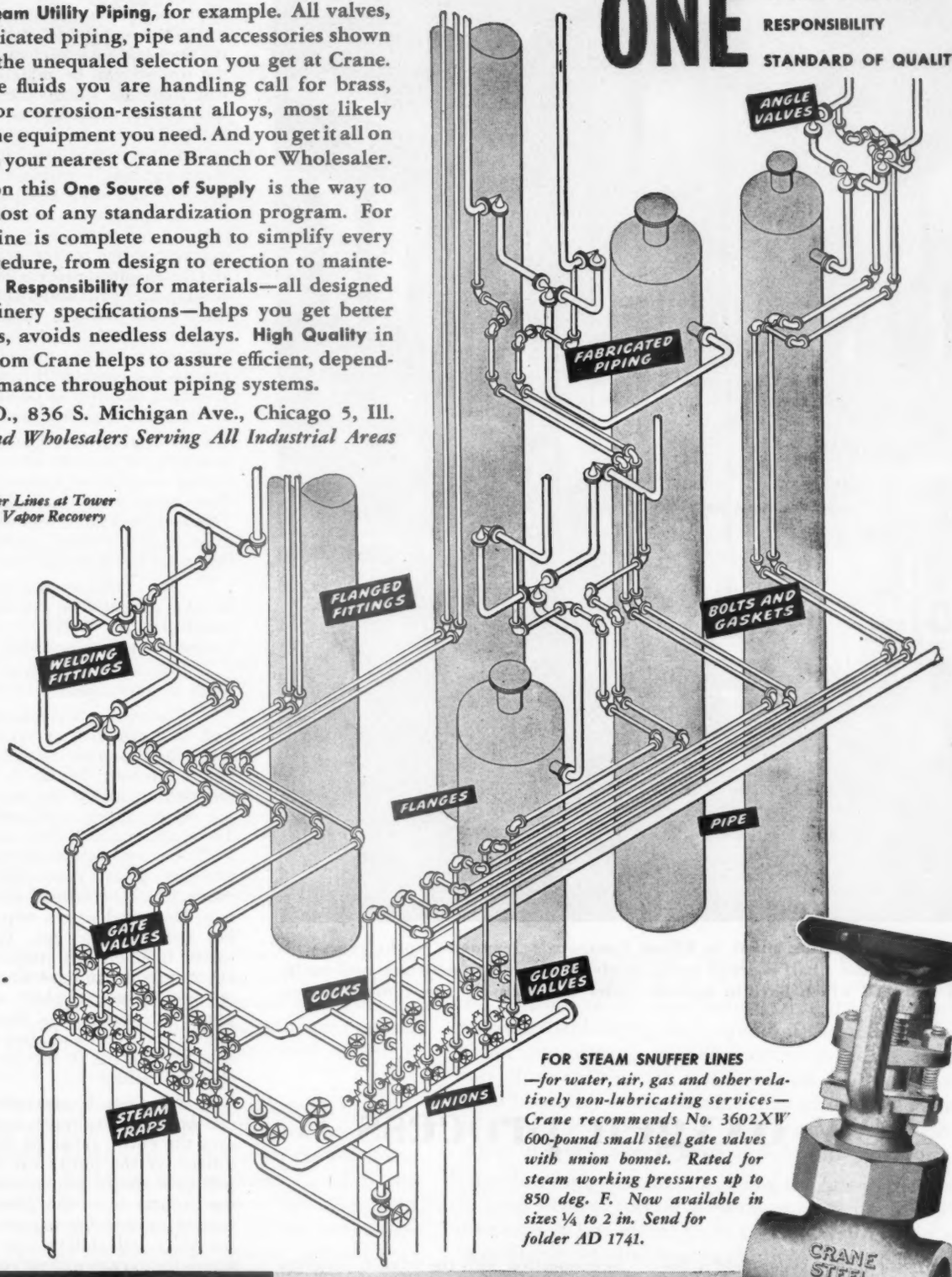

Steam Snuffer Lines at Tower Structure on Vapor Recovery Unit.

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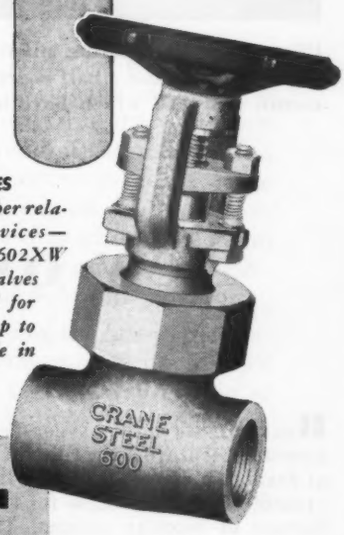

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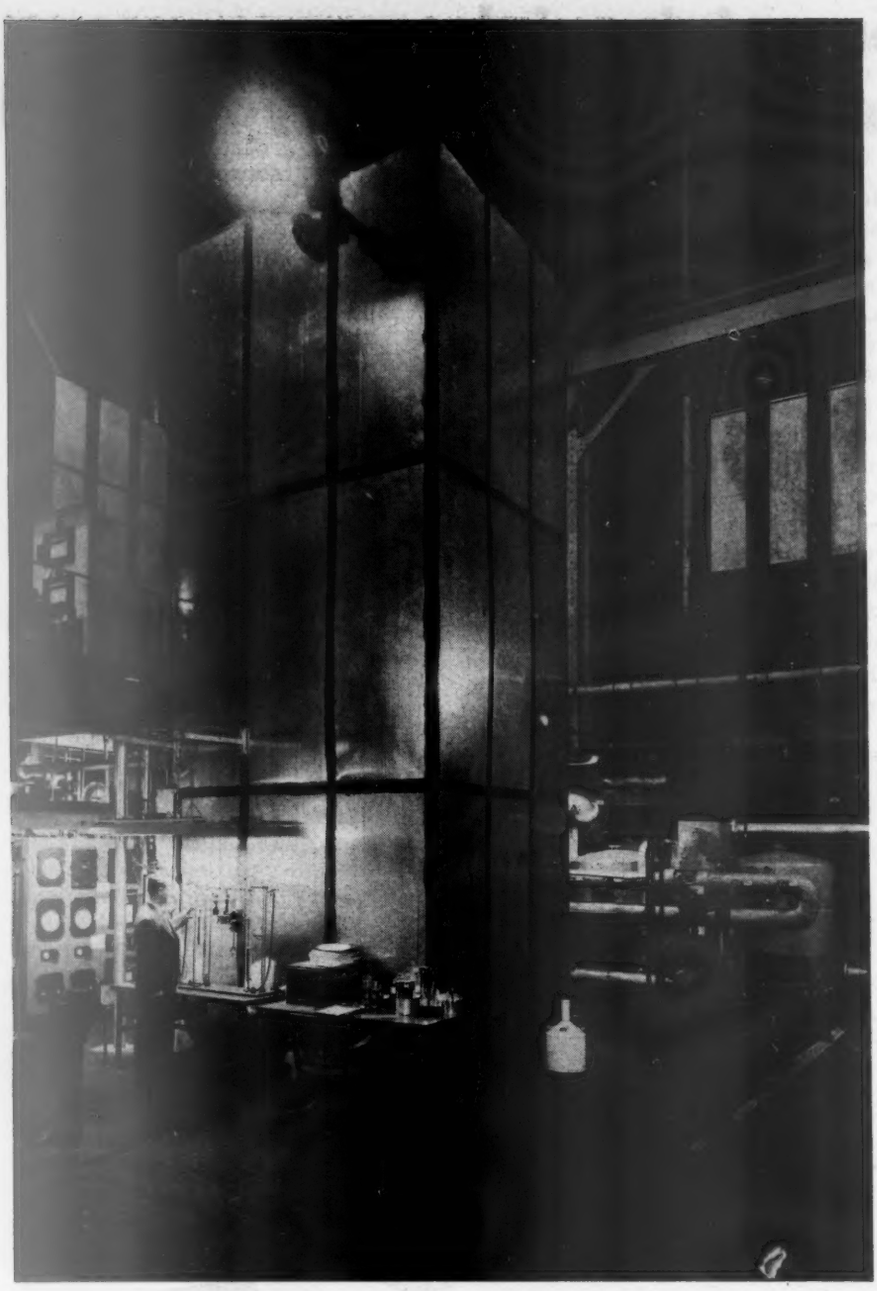


Pilot oxygen-generating plant in Elliott Company's Jeannette works represents more than two and a half years of work, involving use of new materials and equipments, many of which have to operate under exceedingly low temperatures.

New oxygen process

RECENT news in the oxygen field is the announcement from the Elliott Company at Jeannette, Pennsylvania, of the development of a new process for the manufacture of tonnage oxygen. The company has been well known as a supplier of equipment for power plants, steel mills, and the petroleum and process industries. During the war they became active in the development of components in connection with the oxygen program being conducted for the government by the National Defense Research Council. The company's principal contribution was a design for the first low-temperature, turbo-expander produced in this country. The turbo-expander is the heart of any low-pressure system for the manufacture of oxygen and is essentially a small, high-speed, radial flow turbine, the principal function of which is to produce refrigeration at the extremely low temperature levels required for the distillation of air into its components. Useful power is developed as a by-product.

Upon the successful completion of this development, Elliott Company, with an appreciation that the success of all chemical processes is more often assured when the chemical and mechanical aspects of the project can be integrated and unified from the standpoint of design responsibility, embarked on a program of its own to develop a complete oxygen system that would use Elliott manufactured turbines, centrifugal blowers, expanders, and other equipment, in order to be in a position to meet the anticipated demand for plants to produce low-cost tonnage oxygen for the steel, petroleum, and the chemical process industries. This development consumed approximately three years and has culminated in the completion of a pilot plant for 95 per cent purity gaseous oxygen. The Elliott process is a completely new system. The principal features, as pointed out by officials of the company, are:

1. The plant is not subjected to the necessity for periodic shutdowns for deriming in order to remove accumulated deposits of water and carbon dioxide. This feature is important when oxygen is to be used in connection with a process that must be on stream continuously.

2. The system is immune to possible dangers of acetylene explosions, for mechanical means of eliminating dangerous hydrocarbons are provided.

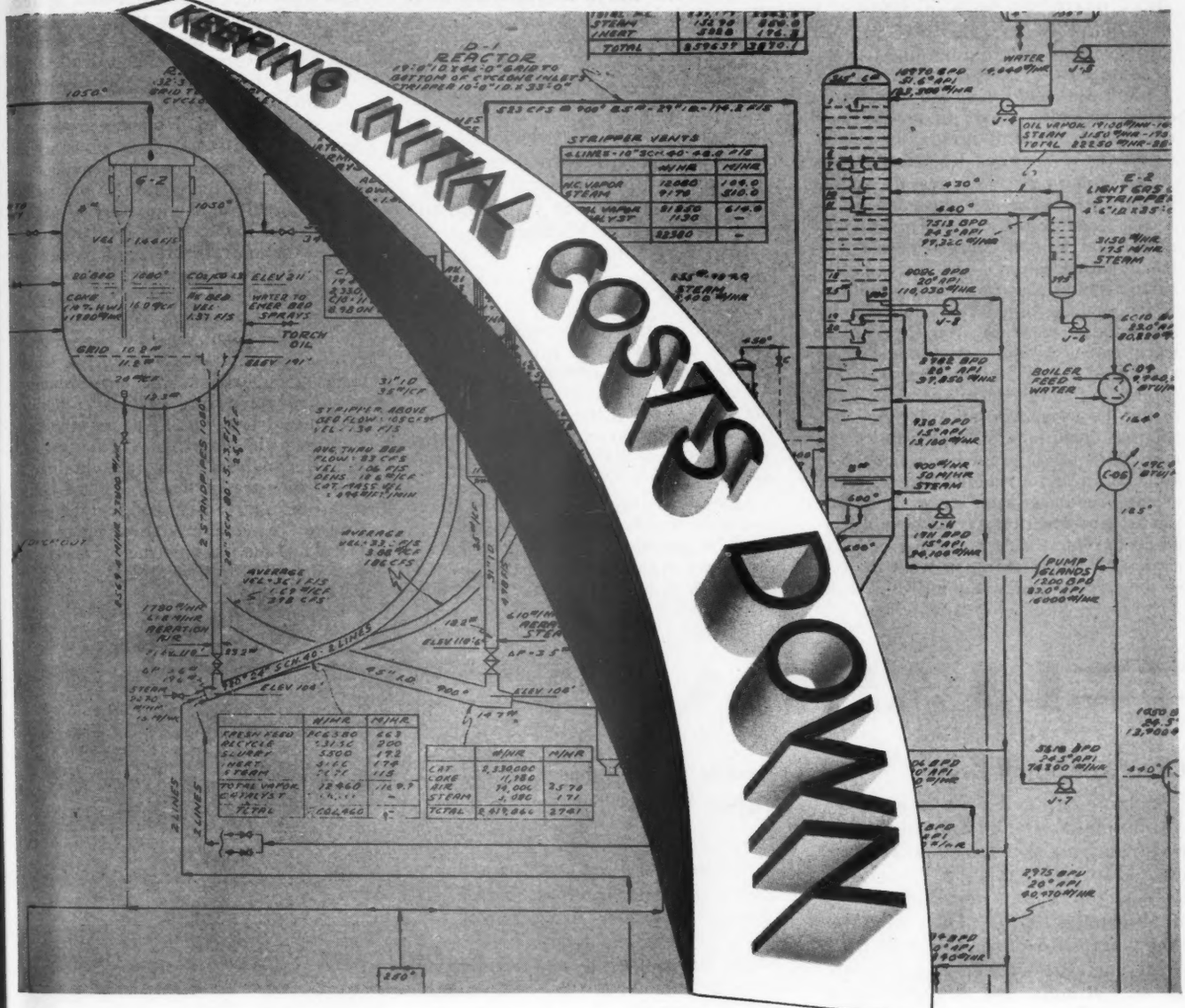
3. The system operates at reduced loads without sacrifice of efficiency.

4. The system is mechanically simplified. Like many other oxygen processes it depends upon reversing heat exchangers to precool the air to liquefaction temperature and at the same time freeze out water vapor and carbon dioxide. These accumulated deposits are periodically removed by reverse flow of effluent nitrogen. These reversals take place every 3 to 4 hr instead of every 2 to 3 min. Heat exchangers require only one hot and one cold gas. The switching valves function less frequently than in other systems, and are also designed to operate at only slightly above atmospheric pressure. This feature reduces maintenance cost and gives added assurance of long life in service without mechanical failure.

5. All controls are automatic. They can be set to maintain constant purity over the entire range of operating conditions, or the purity can be varied at will by a simple adjustment. The automatic controls on the plant can be arranged so that the oxygen plant automatically will follow the process demands for oxygen without requiring manual attention from the operators.

6. The recovery of oxygen from the air is greater than 97 per cent, with the result that minimum power is wasted and the nitrogen leaving the process is sufficiently pure for use as a chemical raw material to manufacture ammonia, nitric acid, fertilizers, or other processes requiring high-purity nitrogen gas. The

N.B. While it is axiomatic that return on investment—the *ultimate earning power* of a refinery unit when actually on stream—is the only true evaluation of competitive engineering recommendations, initial plant costs remain a major factor in refiners' decisions on plant installations. M. W. Kellogg takes specific steps to *minimize initial plant costs* consistent with the achievement of *highest ultimate earning power*.



KELLOGG starts to keep costs down at the precise point where a refinery project starts . . . in process design. For it is the quality of work in the design phase that establishes not only the ultimate earning potential of the unit but also the framework on which initial costs are predicated.

Quality of process engineering is, of course, dependent on the relative ability of individual engineers, their resources in data and experience, the emphasis put on process design by management . . . and, in the final analysis, on the organizational set-up within which the engineers work. Beyond the marked advantages Kellogg can show on the first three factors, its organizational set-up definitely assures *superior quality* in process engineering.

Continued and constant specialization by groups of engineers on every phase of petroleum processing is the keystone of this superiority. Only the volume of business that Kellogg enjoys permits the maintenance of an engineering organization numerically large enough to enable such specialization. The improvement in quality of engineering thus achieved needs no documentation . . . it is as obvious in refinery engineering as in every other branch of technical endeavor.

Superiority in process design is only the first in the continuing series of specific steps taken by Kellogg in the direction of low initial plant costs . . . a succession of individually significant contributions that accumulate substantial savings as each project moves through Kellogg's integrated organization.

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system produces simultaneously high-purity oxygen and high-purity nitrogen.

7. Oxygen as pure as 99.5 per cent can be made. For tonnage production of commercial purity oxygen, analysis shows that it is more economical with the Elliott cycle to make 95-97 per cent purity oxygen and to dilute the product as required for the subsequent process. A plant designed for 95 per cent purity can also simultaneously produce 99.5 per cent purity welding grade oxygen in quantities as required for this purpose.

The process is a low-pressure system in which the air is compressed to about 5 psig, conditioned and cooled to below minus 300 F, and charged to a single fractionating column. The complete distillation takes place within this column, which operates only a few pounds above atmospheric pressure. The entire plant is controlled by temperature distribution and liquid levels within the fractionating column so that all controls can be related to the desired purity and optimum distillation conditions for minimum power consumption. The gaseous oxygen is boiled off from the reboiler and delivered as the product at approximately atmospheric pressure after having been warmed up to room temperature in a heat exchanger. Effluent nitrogen from the top of the fractionating column, which contains not more than 0.5 per cent oxygen is used to provide the refrigeration for precooling the air entering the process. A small portion of this nitrogen is used for the removal of the deposited impurities from the heat exchangers while the bulk of it is available at about 99.5 per cent purity as a nitrogen product.

Like other oxygen systems, refrigeration at extremely low temperature levels must be provided in order to make up for the warm end temperature losses and the heat leak through the insulation into the system. This is accomplished in the Elliott system by an external refrigeration cycle that recirculates pure nitrogen from the top of the column through a heat exchanger and compressor system, and finally obtains the required amount of refrigeration by expansion through the Elliott turbo-expander. This same external refrigeration system is also arranged to produce the liquid nitrogen reflux required as overhead in the column for distillation. The unusual arrangement of components provides for control of the refrigeration and reflux independently of the quantity of air being charged to the system for distillation, so that the controls will compensate automatically for changes in demand and weather conditions for uniformity of product and minimum use of power.

The pilot plant recently completed a continuous nine-week run during which time the operation was entirely automatic except during periods of obtaining special test data. The performance confirmed the correctness of design and from the analysis of the data obtained it was demonstrated that the plant could run indefinitely. Regular acetylene analyses were made throughout the process and at no time was any trace of acetylene ever found in the liquid oxygen where the explosion hazard would exist. ★★

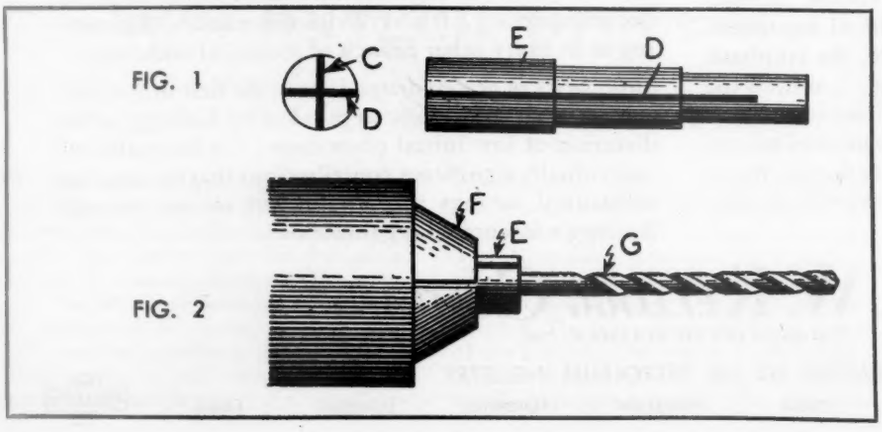
Philblack Sales Division

K. S. Adams, president of Phillips Petroleum Company and of its wholly-owned subsidiary, Phillips Chemical Company, has announced the formation of a new division of Phillips Chemical Company for the sale of Philblack furnace carbon blacks and fertilizer materials manufactured by the company. C. C. Crawford, manager of chemical products department of Phillips Petroleum Company, has been elected vice president and sales manager of Phillips Chemical.

PLANT AIDS

Chuck for Small Drills

Holding a small drill in a brace-and-bit chuck is often a problem. The accompanying sketches show a simple method for doing this job. Turn down a $\frac{3}{16}$-in. rod, E, in "steps" of any desired length, Fig. 1. Then saw two slits lengthwise down the rod, to a point near the smaller end, keeping the slits straight and at right angles to each other as nearly as possible. Insert this auxilliary chuck in the chuck of the brace, to a satisfactory "step" diameter, with the unsawed end inside, insert the drill and tighten the chuck, which clamps the drill shaft, G, tightly. (Fig. 2).—W.F.S.



Electric Heater for Vapor Valve

Instead of using steam, hot water or oil for heating a reducing valve body to prevent forming of ice from moisture and hydrates, an electric heater can be used satisfactorily. This installation handles drips and condensate from a field installation too far removed from the plant for using any of the conventional heating means.

Two electric elements are attached to the valve, one upstream and one downstream from the valve body. Bolth elements are wound around the valve body and connecting piping, placed over the insulation and covered with waterproof asbestos. Current to operate the heaters is led through conduit to the valve where a pair of switches is installed so that one or both elements may be turned on, as the case may require.

Water Conditioning by Graver

PRESSURE WATER FILTERS—A PART OF THE COMPLETE GRAVER LINE

Water filters *may* be the solution to your water conditioning problem. If they are, Graver engineers will recommend their installation. But, if another type or a combination of equipment will meet your requirements more efficiently, more economically, then Graver engineers will recommend that type.

The Graver line is complete. It includes all types of water conditioning equipment... Reactivators, hot process softeners, zeolite softeners, demineralizers, deaerators, condensate conditioners, plus the various combinations of these types that specific conditioning problems demand.

Avoid the danger of installing the wrong equipment. Call in a Graver engineer today. Get a sound, impartial recommendation. There's no obligation.

WATER CONDITIONING AND PROCESS EQUIPMENT DIVISION

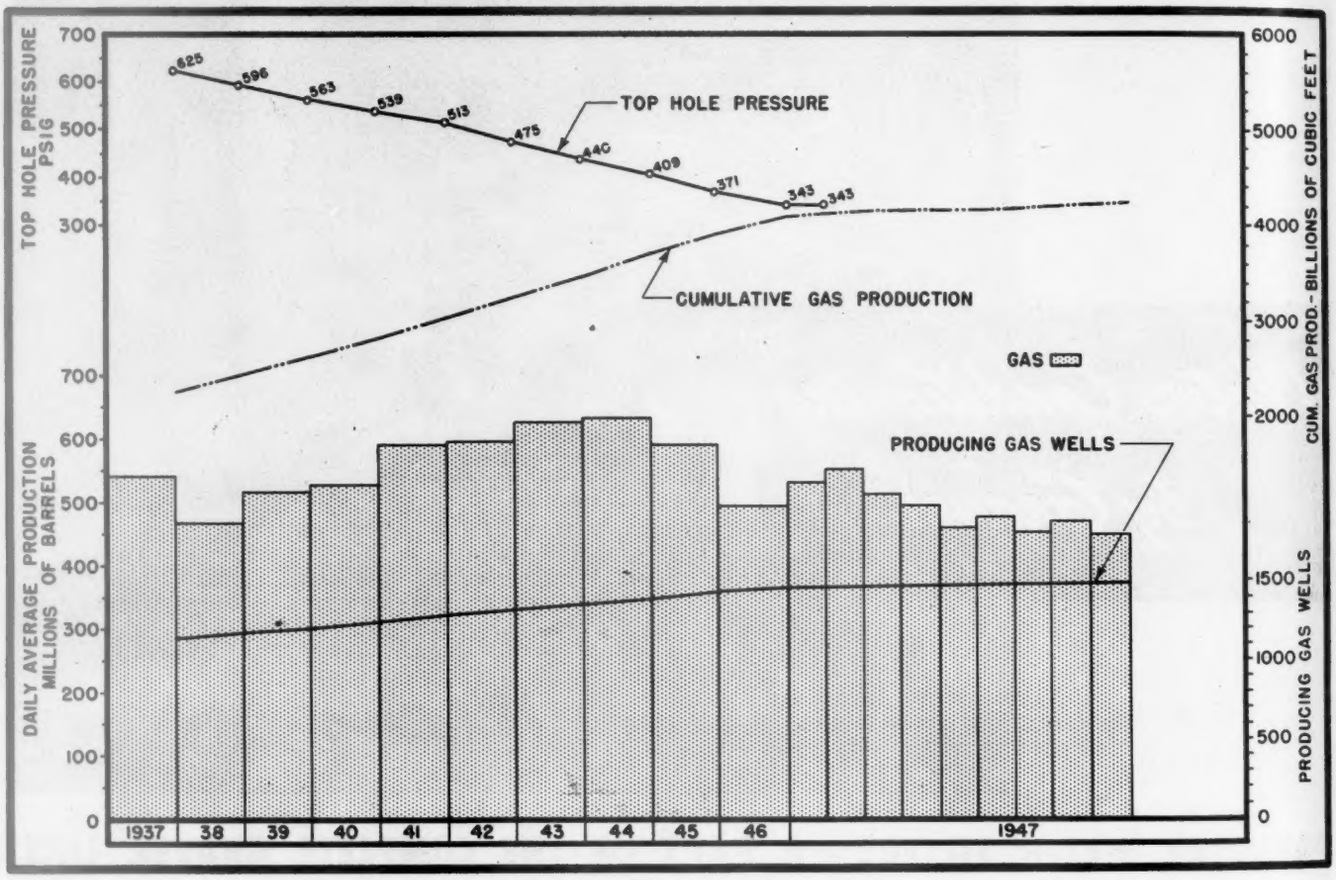
GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

NEW YORK **PHILADELPHIA** **CHICAGO**

MONROE GAS FIELD, LOUISIANA

Location —Union, Ouachita and Morehouse Parishes TS, 18-22N, RS 2-6E
Type of structure —Monoclinal
Producing formation —Monroe "Gas Rock" and Second Sand (latter of minor importance)
Discovery wells —Progressive Oil & Gas Co. Fisher No. 1
Current spacing pattern—157 acres —Average elevation—80′
Original water level (subsea) —Current water level (subsea)—
Top of porosity (subsea)— —Effective section—70′
Bottom hole temperature— Average porosity— Permeability—15 Md
Connate water— Form volume factor— Recovery factor—
Gravity of oil— Gravity of gas—0.6 G.P.M. of gas—0 to 0.6
Original operating GOR— —Current operating GOR—
Top hole pressure— —Original—1,030 psig —Current—343 psig



PRODUCTION STATISTICS

Date	Producing gas wells	Top hole pressure (psig)	Cumulative gas (MMCF)	Daily avg gas (MCF)
January 1947	1,462	343	4,116,000	530,868
February	1,466		4,132,000	550,224
March	1,468		4,148,000	513,514
April	1,473		4,163,000	493,135
May	1,475		4,177,000	458,972
June	1,481		4,191,000	475,310
July	1,486		4,205,000	451,927
August	1,491		4,220,000	468,012
September	1,499		4,233,000	448,569
October				
November				
December				

Source: United Gas Pipe Line Company.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

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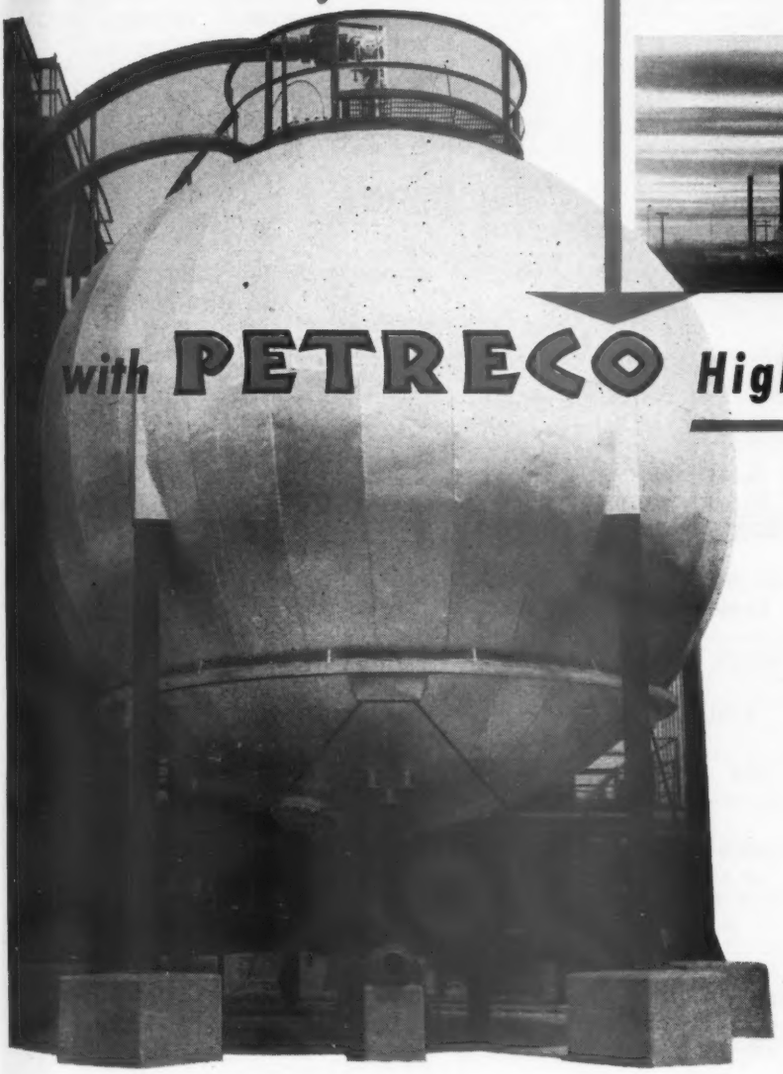
longer continuous runs
decreased coking troubles
no salt plugging, less HCL corrosion
full use of maximum refining capacity



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SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PR 49-3

RUNS TO STILLS OF CRUDE PETROLEUM IN U. S. BY REFINERY DISTRICTS, 1932-1947

(Thousands of Barrels)

ANNUAL TOTALS

District	1932	1933	1934	1935	1936	1937	1938	1939
East Coast:								
Domestic	122,380	132,794	139,916	144,350	154,645	173,737	156,473	163,273
Foreign	40,154	34,138	31,817	25,927	30,834	24,343	24,133	29,108
Total East Coast	162,534	166,932	171,733	170,277	185,479	198,080	180,606	192,381
Appalachian	34,136	33,567	35,809	38,454	38,665	40,286	39,180	43,767
Indiana, Illinois, Kentucky, etc.	106,758	117,073	119,166	129,798	147,724	164,243	163,140	191,634
Oklahoma, Kansas, and Missouri	87,170	96,541	95,006	107,672	114,667	121,238	111,143	112,409
Texas Inland	49,435	57,454	61,941	61,694	67,981	75,415	66,923	65,432
Texas Gulf Coast								
Domestic	146,161	160,215	177,601	195,996	232,147	281,406	306,339	329,981
Foreign	982	476	1,817	4,610	1,111	608	1,567	3,820
Total Texas Gulf Coast	147,143	160,691	179,418	200,606	233,258	282,014	307,906	333,801
Louisiana Gulf Coast:								
Domestic	34,688	38,180	40,115	41,421	44,453	49,697	46,416	48,037
Foreign	1,165	854	1,226	1,594	1,988	1,045	487	562
Total Louisiana Gulf Coast	35,853	39,034	41,341	43,015	46,441	50,742	46,903	48,599
Arkansas and Louisiana Inland	18,297	18,485	18,850	17,416	23,874	24,912	24,089	24,857
Rocky Mountain	13,934	14,209	16,037	19,009	20,738	23,365	24,791	26,306
California	164,737	157,268	156,335	177,849	189,743	203,145	200,334	198,654
Total Domestic	777,696	825,786	860,776	933,659	1,034,637	1,157,444	1,138,828	1,204,350
Total Foreign	42,301	35,468	34,860	32,131	33,933	25,996	26,187	33,490
Total United States	819,997	861,254	895,636	965,790	1,068,570	1,183,440	1,165,015	1,237,840

DAILY AVERAGES

District	1932	1933	1934	1935	1936	1937	1938	1939
East Coast:								
Domestic	334.4	363.8	383.3	395.5	422.5	476.0	428.7	447.3
Foreign	109.7	93.5	87.2	71.0	84.3	66.7	66.1	79.8
Total East Coast	444.1	457.3	470.5	466.5	506.8	542.7	494.8	527.1
Appalachian	93.2	92.0	98.1	105.8	105.7	110.4	107.3	119.9
Indiana, Illinois, Kentucky, etc.	291.7	320.8	326.5	355.6	403.6	450.0	447.0	525.0
Oklahoma, Kansas, and Missouri	238.2	264.5	260.3	295.0	313.3	332.1	304.5	308.0
Texas Inland	135.0	157.4	169.7	169.0	185.7	206.6	183.3	179.3
Texas Gulf Coast								
Domestic	399.3	439.0	486.6	537.0	634.3	771.0	839.3	904.0
Foreign	2.7	1.3	5.0	12.6	3.0	1.7	4.3	10.5
Total Texas Gulf Coast	402.0	440.3	491.6	549.6	637.3	772.7	843.6	914.5
Louisiana Gulf Coast:								
Domestic	94.8	104.6	109.9	113.5	121.5	136.2	127.2	131.6
Foreign	3.2	2.4	3.3	4.4	5.4	2.8	1.3	1.5
Total Louisiana Gulf Coast	98.0	107.0	113.2	117.9	126.9	139.0	128.5	133.1
Arkansas and Louisiana Inland	50.0	50.6	51.7	47.7	65.2	68.2	66.0	68.1
Rocky Mountain	38.1	38.9	43.9	52.1	56.7	64.0	67.9	72.1
California	450.1	430.8	428.3	487.3	518.4	556.6	548.9	544.3
Total Domestic	2124.8	2262.4	2358.3	2558.0	2826.9	3171.1	3120.1	3299.6
Total Foreign	115.6	97.2	95.5	88.0	92.7	71.2	71.7	91.8
Total United States	2240.4	2359.6	2453.8	2646.0	2919.6	3242.3	3191.8	3391.4

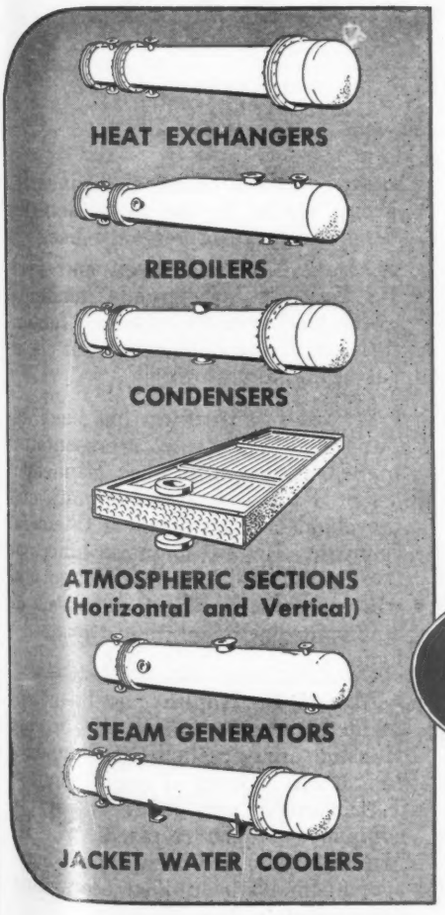
Source: U. S. Bureau of Mines.

(Continued)

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

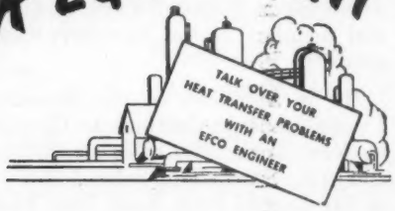
If your problem is the poor performance or high maintenance cost of your heat transfer units, consult an EFCO engineer. He will help you decide the changes or modifications necessary to get the desired performance from your heat transfer equipment.

Backed by knowledge and experience, EFCO engineers are constantly working to produce heat transfer units that will give efficient performance and long, trouble-free operation.



ENGINEERS & FABRICATORS, INC.
P. O. Box 7395 Houston 8, Texas

EFCO HEAT TRANSFER EQUIPMENT



Refining Headliner

Wilbur F. Burt

VICE PRESIDENT of the Socony-Vacuum Oil Company, Inc., and a member of the executive committee, Wilbur F. Burt, was instrumental in 1937, when chairman of Socony-Vacuum's manufacturing committee, in developing the Houdry Catalytic Cracking Process for production of high quality gasoline and for launching it in commercial operation. At present he is coordinator of all foreign and domestic departments within Socony-Vacuum.

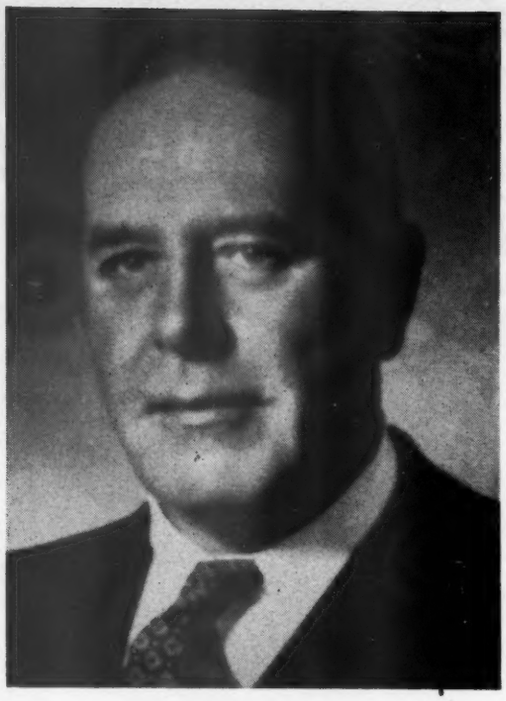
Born in "the Gay Nineties" in Ocean Grove, New Jersey, Burt has two sons, makes a hobby of fishing and golf. With regard to the latter, he is not a "par-buster," he admits, but manages usually to keep well below 100. One son, Donald P., is a doctor with a captain's commission in the U. S. Army; the other son, Wilbur F., Jr., is assistant sales manager for a large New York firm.

After attending Peddie School, Burt entered Amherst College and upon being graduated in 1912 started with the Standard Oil Company of New York. He was an assistant superintendent of the Queens County, New York, refinery when he left in 1917 to join "this man's Army" for the first World War.

After "making the world safe for the Democrats," in 1919 he became superintendent of the Pratt refinery in Brooklyn and, in 1923, was made general superintendent of the paint and cooperage department. Three years later he became manager of the safety and claims department at the New York headquarters of Standard Oil of New York, 26 Broadway. Transferred in 1927 to the manufacturing department as assistant to H. C. Smart, he succeeded Smart as chairman of the manufacturing committee in 1928 and became a member of the company's board of directors in 1931.

Following formation of the Socony-Vacuum Oil Company, Inc., Burt became vice chairman of the company's manufacturing committee and in 1935 he was made chairman. He was elected a director in 1939 and a vice president and member of the Executive Committee in 1944.

He is a trustee of the Brooklyn Trust Company, Community Hospital in New York, of Collegiate School, and of the Storm King School. He lives at 101 Central Park West, New York.



WILBUR F. BURT

PERSONALS

▸ **D. R. Johnson** is the new manager of Continental Oil Company's manufacturing department, with supervision over the company's eight refineries. Johnson joined Continental as an electrician at the Glenrock, Wyoming, refinery in 1924. Formerly manager of the southern region of the manufacturing department, Johnson will be succeeded by **L. W. Vickery,** superintendent of Continental's Ponca City refinery.

Charles D. Hull, formerly assistant to the vice president, has been named superintendent of the Ponca City plant. He will be succeeded by **C. B. Round,** former analyst in the company's coordinating and planning department.

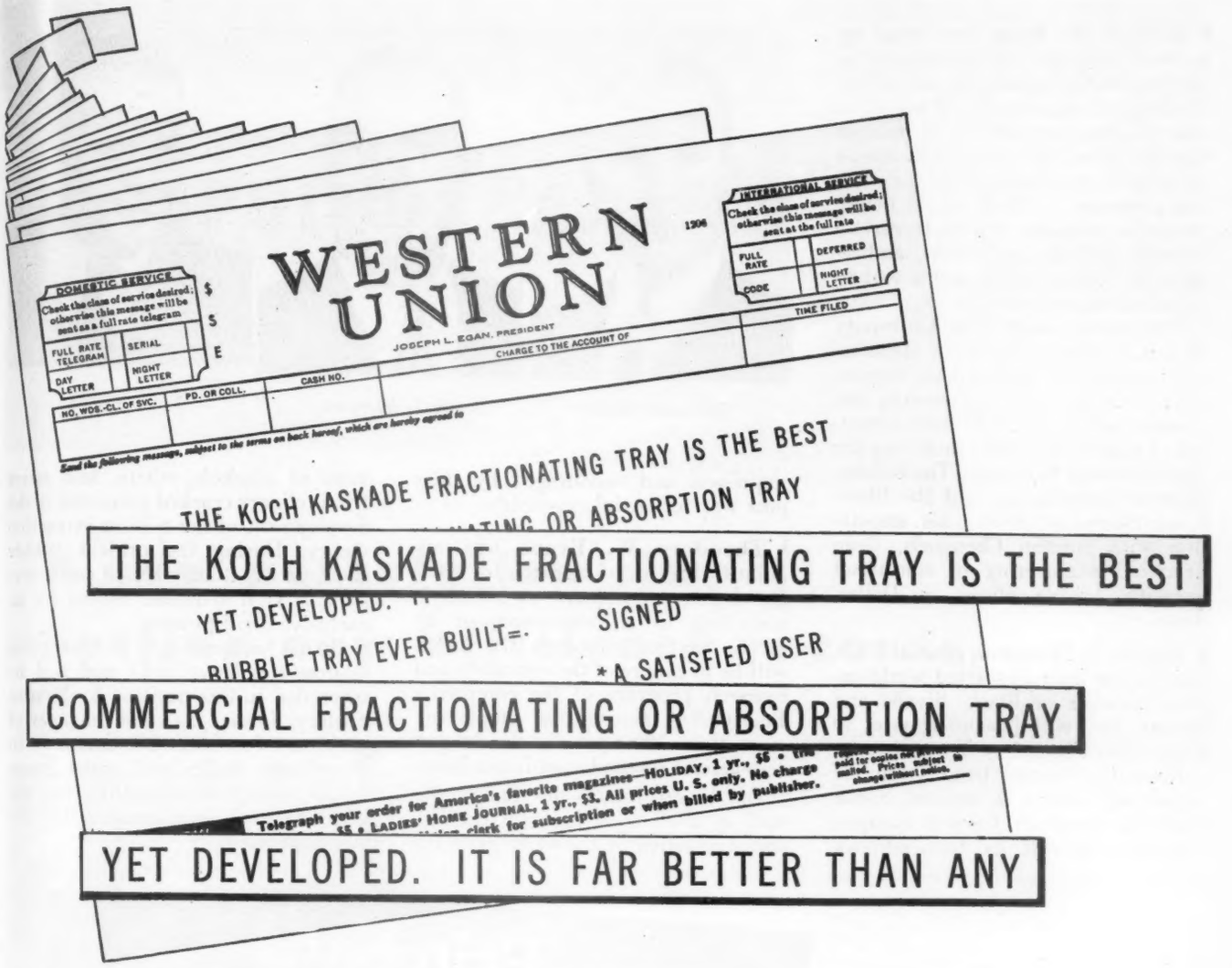
▸ **Evert W. Kilgren** has been made a project engineer in the manufacturing department of Stanolind Oil and Gas Company's Tulsa general office. He has been a chemical engineering group leader.

Arthur H. Denny became an operating engineer and **John M. Hillsman** became a chemical engineering group leader in the manufacturing department, Tulsa general office.

Lloyd L. Christensen and **Jack P. Barrett** were made technical group leaders at the research laboratories in Tulsa. Both have been chemists at the laboratories.

▸ **Howard Millington** has been appointed chemical sales representative in the Chicago, Milwaukee, Minneapolis, St. Paul, Detroit, Cincinnati, and Cleveland area for Spencer Chemical Company. He will maintain offices at 208 South LaSalle Street, Chicago, and will represent Spencer on the sale of ammonia, methanol, and formaldehyde.

▸ **Alfred F. Hagen** has been appointed treasury manager for the Houston area of Shell Oil Company, Inc., it was announced recently by Joe T. Dickerson, area manager for the company. Hagen replaces **E. R. Mueller,** who has been named manager of Shell's head office accounting department in New York.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Tilford H. Bean has been appointed manager of manufacturing for Stanton Chemicals Inc. and will be in charge of the company's new plant now nearing completion at Corpus Christi, Texas. His duties will consist principally in coordinating the various processes involved in the manufacture of aromatic type hydrocarbon solvents, phthalic anhydride, anthraquinone, organic acids and a variety of petroleum specialties.

Bean is a graduate of the University of Texas with a degree in chemical engineering and he has held responsible positions in the engineering and chemical processing fields with a number of major companies including the Dow Chemical Company, The Rubber Reserve Corporation, and the Blaw-Knox Company. Before his association with Stanton Chemicals, Bean practiced engineering in consultant capacity, having offices in Dallas, Texas.

Harlan L. Mumma, general USA, retired, has been appointed world export manager of Black, Sivalls and Bryson, Inc., with headquarters at 30 Rockefeller Plaza, New York City.

Recently returned from a tour of industrial centers in several South American countries, General Mumma expressed himself as tremendously impressed and encouraged by their post war industrial expansion.

Tilford H. Bean

H. L. Mumma

T. W. Evans

Theodore W. Evans was appointed director of research for Shell Development Company on March 1, according to an announcement by M. E. Spaght, president. Dr. Evans will be in charge of the operation and research program of the company's Emeryville laboratories employing more than 1000 people, the largest commercial research unit in the West.

Dr. Evans joined the Emeryville staff in 1930 as a research chemist and was active in the early development of alcohols, ethers, and esters from refinery cracked gases and in the development of the solvent extraction theory. During the critical rubber shortage his studies led to early supplies of vital synthetic rubber by an exclusive Shell process.

He has been manager of Emeryville laboratories since 1947 and will be succeeded in this position by **Bruno Stolley,** former assistant manager of personnel for Shell Oil Company in New York. Stolley will assist Evans by assuming responsibility for the administrative management of the laboratories.

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COOLING TOWERS

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... Adequately Sized
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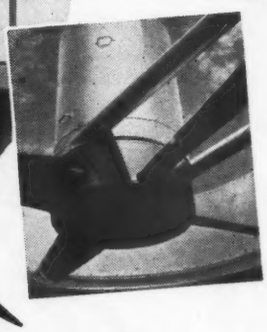

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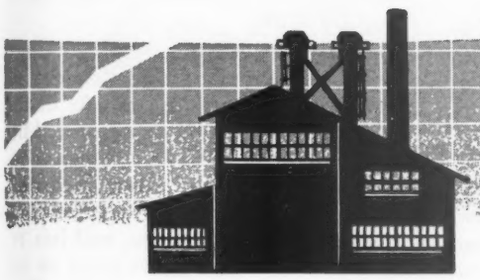
A new percolation clay
Setting new efficiency records



Attapulgus—foremost name in fullers earth—now offers a *new* percolation clay, the high efficiency of which has been proved by many months use in one of the larger oil refineries in the country.

Its name—Attapulgus "AAA" Grade Clay.

Its record:

REDUCED CLAY COSTS. With most oils, "AAA" has 10% to 20% more refining efficiency than other available percolation clays—a superiority maintained over the entire life of the clay. This permits using "AAA" through more cycles, reducing clay costs by 15% to 25%.

OPERATING CREDITS. The higher percolation yields per ton of "AAA" clay mean fewer filter turnovers, less clay to burn, lower oil and naphtha losses, reduced steaming costs, lower maintenance costs on burner equipment, etc. These savings are two to three times as great as the reduction in clay costs.

INCREASED YIELDS. Just install "AAA" and yields go up. The same production can be maintained at a lower unit product cost. Or, "AAA" will give your present facilities added capacity.

"AAA" Grade Clay is available in standard percolation meshes—in bags or bulk.

We are ready to assist you in its evaluation for your particular filtering operation.

ATTAPULGUS CLAY COMPANY

Dept. Y, 210 West Washington Square, Phila. 5, Pa.

Floyd V. Snodgrass has been named general manager of the Nordstrom Valve Division's Oakland, California plant, according to announcement by W. F. Rockwell, Jr., president of Rockwell Manufacturing Company. Snodgrass started with the company in 1935 as a machinist in the Oakland plant. He advanced through the organization to plant manager, assistant general manager and now general manager. In February, 1948, he was named "Man of the Month" by two West Coast metal working publications.

Henry B. Hass of Purdue University has been appointed manager of research and development of General Aniline and Film Corporation, Jack Frye, president, has announced. Dr. Hass received his Ph.D. from Ohio State University in 1925. He became a teacher at Purdue in 1928 and has been head of the chemistry department since 1937.

During World War II he was closely associated with the Manhattan Project for Atomic Energy. For many years Dr. Hass has been a consultant to chemical corporations. He is the holder of scores of patents covering chemical products and processes, and he is the author of many technical papers related to organic chemistry. He was elected to a fellowship in the Royal Society of Arts in November, 1948.

George W. Stroup, Jr., recently joined the sales department of Nelson Electric Manufacturing Company in Tulsa, Oklahoma, where he is representing the company as a sales engineer in the Tulsa territory. Stroup acquired previous sales and engineering experience while employed by Roach Equipment Manufacturing Company and Buda Engine Sales and Service, Inc.

M. W. Reed has been appointed vice president-engineering of United States Steel Corporation of Delaware, succeeding **B. H. Lawrence,** who is retiring after more than 44 years service with United States Steel. Reed has served with subsidiaries of United States Steel continuously since 1916.

Afton D. Puckett has been promoted to district laboratory coordinator in the Petroleum Chemicals Division of the Du Pont company. Formerly in charge of studies of antiknock properties of motor fuels in Du Pont's combustion engineering laboratory at Deepwater Point, New Jersey, Puckett will now coordinate technical services extended by Du Pont through five district laboratories to the oil refining industry of the entire country in connection with its use of tetraethyl lead and other petroleum chemicals.

John N. C. Cameron has been appointed manager of the division's Gulf Coast district laboratory at 4141 Dennis Street, Houston, Texas. He has been with the Humble Oil and Refining Company for the past seven years at Baytown, Texas. His experience there included octane rating and light oil analytical research and pilot scale research on catalytic treating. The Du Pont laboratory he will manage will serve refineries in Louisiana, Arkansas, New Mexico, and Texas with the exception of the Panhandle.

John R. McNulty has resigned as division director of personnel with The Ohio Oil Company at Casper, Wyoming, to become manager of industrial relations for Husky Refining Company at Cody, Wyoming. A graduate of the University of Wyoming with degrees in Economics and Law, he was with Ohio for 15 years and spent 4 years in the Air Corps. A member of the Wyoming Bar and active in oil industry training, personnel, and labor relations activities, he is president of the recently organized Rocky Mountain Refiners' Association and chairman of the Operating Committee of the Rocky Mountain Oil Industry Training Programs.

Nils M. Smith-Petersen has joined the public relations staff of Walter Weir, Inc. He has had ten years of diversified experience including both the technical and the general branches of public relations and publicity. During the war, he served as AAF pilot in Italy and later headed the Press Branch of the AAF Office of Public Relations in Washington, D. C.

O. B. Wilson, eastern regional sales manager for Brown Instruments division of Minneapolis-Honeywell Regulator Company, was named manager of sales for the east, southeast, and central regions, announced L. Morton Morley, Brown's vice president and general sales manager. Wilson, who has been with Honeywell for 25 years, will make his headquarters at the Brown plant in Philadelphia.

L. R. Goldsmith

S. J. Meisenburg

L. R. Goldsmith, superintendent of Shell's Wilmington-Dominguez Refinery has been transferred to the company's head office in New York, according to F. S. Clulow, manfacturing vice president. His new assignment will be in the economic development department, headed by N. J. McGaw, vice president. Goldsmith received his petroleum engineering degree at the University of California, and has been with Shell since 1932, in the manufacturing department. During the war, he spent two years in Washington, D. C., in the refining division of the Petroleum Administration for War.

S. J. Meisenburg replaced Goldsmith as refinery superintendent. A chemical engineering graduate of the University of Michigan, he started his Shell career in 1935 as a research engineer in the Wood River Refinery. He has had extensive experience in Shell's Eastern refineries, and has recently been assistant manager of research and development in the New York office.

Charles T. Mentzer, Jr., assistant manager of fine chemicals sales in the Du Pont organic chemicals department, has been named sales supervisor in the department's New York office. He will take new position January 1.

Charles W. Snyder, formerly sales manager for Hanlon Waters Company, is the head of the Snyder Company, Inc., 1001 North Wheeling Street, Tulsa, Oklahoma. Handling numerous well known lines his firm specializes in control valves and instruments.

Neil S. Whitmore has been made assistant plant superintendent at the Slaughter gasoline plant near Levelland, Texas, according to an announcement from the Stanolind Oil and Gas Company. He has been at the site during construction as a field project engineer.

Glenn A. Ayling was named foreman at the Slaughter plant, and **Jack E. Fulgham** was made plant engineer. Both were previously assigned to the engineering staff of the manufacturing department in Tulsa, Oklahoma.

reduce maintenance costs

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SUBSTANTIAL savings in maintenance costs are being realized by many petroleum refineries, chemical plants and by-product coke plants, who are handling their condensing and cooling services with NATIONAL Sections.

Economy in maintenance is inherent in NATIONAL Sections for the following reasons:

- *Simplicity of Design*
- *Ease of Assembly and Replacement*
- *Long Life due to Corrosion Resistance of Cast Iron*
- *Low Spare Part Inventory Requirements*

For information concerning NATIONAL Condensing and Cooling Sections, please write for our Catalog CP-16.

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▸ **H. W. Fisher,** a director and general manager of East Coast refineries of Esso Standard Oil Company, has been appointed deputy coordinator of refining activities for Standard Oil Company (New Jersey). Fisher, whose entire business career has been

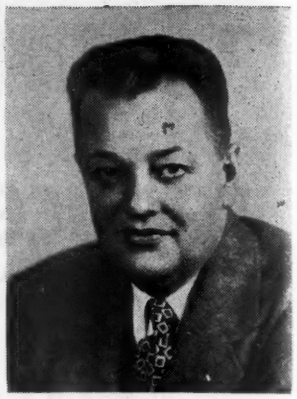
H. W. Fisher

with affiliates of Jersey Standard, joined the organization 21 years ago, immediately after he was graduated from the Massachusetts Institute of Technology with a degree in chemical engineering. Much of his career has been devoted to the development and production of chemicals from petroleum.

▸ **C. S. (Buck) Worley,** chief engineer and purchasing agent, consolidated Gas Utilities Corporation, Oklahoma City, retired from company service March 1. Worley is opening an office in the Braniff building in Oklahoma City as a consultant on design of natural gasoline plants and booster stations. He will also establish a general appraisal practice. Worley has been with the Consolidated Gas Utilities Corporation for 20 years. He has had charge of all plant design and operation.

▸ **William H. Buley** was appointed manager of stainless steel sales of The Babcock and Wilcox Tube Company, Edward A. Livingstone, vice president in charge of sales has announced. Buley will maintain headquarters in the general offices of the company at Beaver Falls, Pennsylvania.

▸ **C. A. Scharschu,** director of research of Allegheny Ludlum Steel Corporation, has been appointed assistant technical director, it was announced by F. B. Lounsberry, the company's technical director. **Dr. L. C. Hicks,** associate director of research, will fill Scharschu's former position.



General Hauseman

▸ **Brig. Gen. David N. Hauseman,** president of Houdry Process Corporation has been elected to the board of managers of the Girard Trust Company of Philadelphia, Pennsylvania. General Hauseman has been president of the Houdry corporation since early 1948, and at that time was elected chairman of the board of directors of the Catalytic Construction Company, Houdry subsidiary. He is also a Trustee of Temple University and a Director of the Research Institute of the University. General Hauseman retired from the Army on his own application after 30 years' service. He was awarded both the Legion of Merit and the Distinguished Service Medal.

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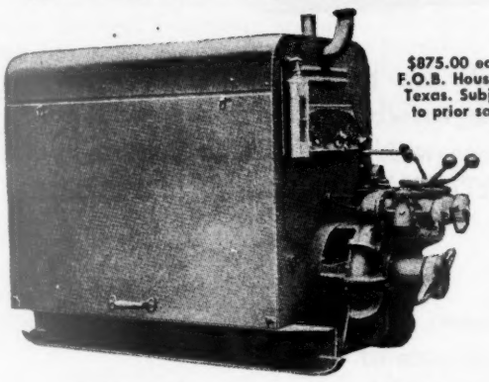

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DSP INC. ORGANIZATIONS

NEWS

WPRA Annual Meeting

The Western Petroleum Refiners Association will hold its 37th annual meeting in San Antonio, Texas, March 28-30. The program is designed to cover trends and developments in refinery technology, according to John C. Day, association executive secretary.

Papers to be heard will include such subjects as Houdriflow Catalytic Cracking, Hydroforming, Fuels and Lubricants for Jet Propelled Aircraft, Storage Stability of Cracked Fuel Oils. In addition to these papers, Dr. Edwin F. Nelson, vice president of Universal Oil Products Company, will present at the March 28 morning session his company's paper entitled "Trends in the Refining Industry."

Desulfo Plant

Stacey-Dresser Engineering Division, Cleveland, Ohio, one of the Dresser Industries, has received authorization from the Panhandle Producing Company, San Antonio, Texas, to furnish an automatic Desulfo plant for erection near Stinnett, Texas. The plant will have a potential capacity of 2,750,000 cu ft per day, and will automatically remove excess hydrogen sulphide from natural gas. Work has already commenced at the site, and construction of the plant is scheduled to start early in April.

Desulfo plants are built in four standard sizes and are capable of processing gas that contains up to 1500 grains of hydrogen sulphide per 100 std cu ft.

Oklahoma Gasoline Plant

R. D. Hanley, director and manager of Magnolia Petroleum Company's natural gas department, has announced that a contract has been awarded to Jones and Laughlin Company of Tulsa, Oklahoma, for the construction of a natural gasoline plant in the Sholem Alechem Field in the eastern part of Stephens County, Oklahoma, about two miles southwest of Tussy. It is estimated the plant will be in operation by the first of next year.

The initial installation of compressors will be capable of processing 22,000,000 cu ft of casinghead gas per day and the plant is designed for the ultimate processing of 30,000,000 cu ft daily. It is designed for a total production of about 75,000 gal per day of natural gasoline and LP-gas. All residue gas not used for plant and lease fuel will be sold for pipe line transportation to commercial markets.

The project is a joint operation with Magnolia as the plant operator for the group composed of nine companies and nine individuals. Besides Magnolia, the group consists of Amerada Petroleum Corporation, Stanolind Oil and Gas Company, Atlantic Refining Company, Alma Oil Company, Champlin Refining Company, Eason Oil Company, Republic Natural Gas Company, and Wave Exploration Company. The individuals are Walter Duncan, Oklahoma City; W. J. Hunter, Shreveport, Louisiana; Edwin L. Cox, Dallas; L. W. Winkler, Denver, Colorado, and Paul F. Brennan, E. W. Hamilton, Frank B. Murta, J. E. Tomaney, and Robert Wilson, all of Tulsa.

New TCC Unit

After a successful test run of its new Thermofor catalytic cracking unit at Denver, Continenal Oil Company has accepted the unit. Capacity rating is 6600 bbl per day.

Standard Buys Half Interest In Two Italian Refineries

Standard Oil Company (New Jersey) has anounced it has signed agreements to acquire 50 per cent interest in a new company that will own and operate oil refineries at Leghorn and Bari, Italy, having a combined capacity of about 16,000 bbl of crude oil daily. Sharing the other half of the new company will be Anic (Azienda Nazionale Combustibili), present owners of the refineries whose stock is all Italian-owned.

The properties to be acquired by the new company are currently valued at $12,000,000, it was announced. Meanwhile, plans are being studied for modernization of the facilities of both refineries. At present, both plants have been rehabilitated and the combined capacity increased from 12,000 bbl prewar to the present rate, utilizing crude oil from convenient Middle East sources. The refinery output will be marketed in Italy through SIAP, the Italian affiliate of Standard Oil Company (New Jersey.)

Tube-maker's Dream. *Photograph shows new Babcock & Wilcox boiler going into the Akron power plant of Ohio Edison Company, late in December, 1948. Boiler will make 450,000 lb of steam per hour at 925 psig and superheated to 900 F. Many miles of tubes are included in the installation, as is testified to by air heater alone (at back of boiler) which contains approximately 30 miles of tubes.*

Pacific Coast Wax Plant

A new major wax plant for the Pacific Coast and the west is in production at the Richmond refinery of the Standard Oil Company of California. Capable of manufacturing 45,000,000 lb of wax a year, the new plant has been under construction since the easing of the equipment and supply situation following the end of the war.

The new plant will produce refined wax of high, medium, and low melting points from California crude. Shipment from the Richmond refinery is made in 10 lb slabs, 100 lb cartons of slabs and 220 lb bags of slabs. Loose slabs can be shipped in paper lined box cars. Bulk shipments are in steam coil tank cars, direct from the refinery.

About 29 per cent of production will be of the most pliable, low-melting point grade, 125 to 130 AMP, most of which will be used in milk cartons. Around 54 per cent will be of medium melting point for waxed paper, and the remaining 17 per cent of higher melting point wax will be used for specialized purposes.

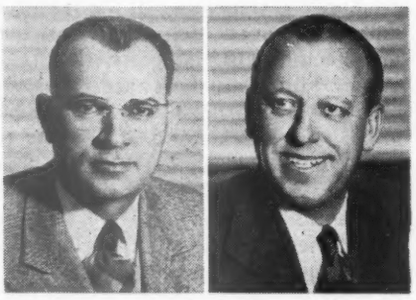
Jet Fuel Requirements

Air Force and Navy jet fuel requirements for the current fiscal year, totaling 3,293,000 bbl, are completely covered, and the Armed Services Petroleum Procurement Agency was able to turn back a slight surplus offered, agency spokesmen disclosed.

If the 70-group Air Force plan is put through, or anything larger than the present force is approved, jet fuel needs during the next fiscal year will go up proportionately. However, if President Truman's budget recommendations for the Air Force are approved there will be little or no change from this fiscal year. During the past two years, ASPPA officials said, jet fuel requirements have increased from about one-fiftieth of total military needs to about one-fifth or one-sixth.

Fluor Names New Officers

The Board of Directors of the Fluor Corporation, Ltd., Los Angeles, recently announced its officers for 1949. Shirley E. Meserve, general counsel for the company since 1929 and its president since 1947, was elected chairman of the board. Succeeding him as president is Donald W. Darnell,



D. W. Darnell *J. S. Fluor, Jr.*

who joined Fluor in 1925 as an engineer and has worked up through the ranks.

Actively connected with the development and management of the Fluor Corporation during the years 1921-1946, J. S. Fluor, Jr. has returned and been elected executive vice persident. A reorganization of the company into two major divisions necessitated other management shifts. W. Earl Dunn, formerly executive vice president, was named vice president and general manager of the engineering and construction division, and J. Robert Fluor, formerly vice president and assistant general manager, was appointed vice president and general manager of manufacturing division.

New Laboratory

Cities Service Oil Company has completed a new technical service laboratory at its East Chicago refinery. Functions of the new laboratory are primarily sales service, service testing, and product evaluation. In addition, the laboratory will serve as the central testing point for product quality control during manufacture. Special investigations will be conducted relating to refinery operations such as corrosion control, waste disposal, chemical treatment, and general processing improvements. The laboratory operates under the direction of the manufacturing division, H. W. Camp, manager, and T. E. DeVilliers, chief chemist.

API Refining Division Meets

The Division of Refining of the American Petroleum Institute will hold its mid-year meeting in Houston, Texas, at the Shamrock Hotel on April 4-7. There will be seven technical group sessions and a dinner session.

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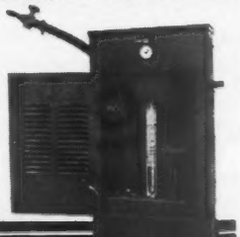

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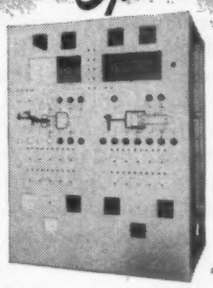

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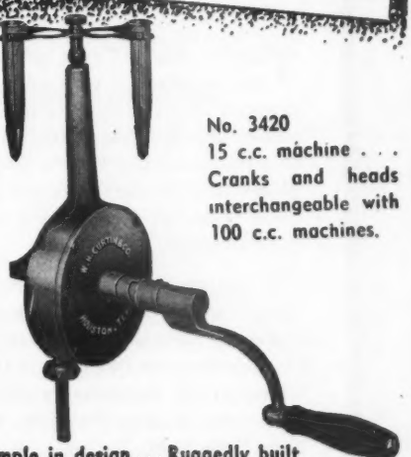

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Synthetic Fuels Paper

Published information on the production of synthetic liquid fuels by the Fischer-Tropsch process, and Bureau of Mines research on catalysts used in the process, are described in a new technical paper released by Bureau Director James Boyd.

Copies of Technical Paper 709, "Synthetic Liquid Fuels From Hydrogenation of Carbon Monoxide, Part 1," can be obtained only from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 50 cents each. This Technical Paper is not sold by the Bureau of Mines.

Belgian Refinery Operating

The Antwerp refinery of the "Albatros" (formerly "Redeventza") Société Anonyme Belge pour le Raffinage de Pétrole, which is the largest refinery in Belgium, was badly damaged during the war. Reconstruction work has recently been completed and the refinery has resumed operation at an estimated throughput of about 2400 bbl daily. Middle East crude oil will be a principal charge stock. The resumption of work at the refinery will considerabely reduce Belgian foreign exchange requirements.

Process Book Available

The second edition of "Conversion of Petroleum," by A. N. Sachanen, was prompted by the extraordinary developments in petroleum processes during the period between 1940, date of the issue of the first edition, and 1948; much of this advance is traceable to the exigencies of the World War, the author indicates. Author Sachanen is a member of the research and development department of Socony-Vacuum Oil Company, Inc.

In addition to the chapters in the original work, most of which have undergone greater or less revision to bring them up-to-date, the author has revised importantly the chapter on reactions of hydrocarbons and the one on synthetic gasolines, to include the large amount of new data that found its way into the literature during that 8-year interim. Entirely new chapters have been added on conversion of petroleum gases into motor fuel and on catalytic cracking, their addition made for obvious reasons. The chapter on gas conversion discusses the most recent developments in alkylation, polymerization, cracking, isomerization, dehydrogenation; the so-called Fischer-Tropsch-derived processes are discussed showing methods for synthesizing liquid hydrocarbons from carbon monoxide and hydrogen. Catalysts and their composition and specific activities are given considerable attention in this chapter.

Catalytic cracking is covered under both the activities of so-called acidic catalysts such as aluminum chloride-HCl complexes and the adsorptive catalysts such as alumina-silica, alumina-chromia, and other catalysts. The use of the "retreat" method of catalytic treatment for aviation gasoline is in reality a reforming process, the author points out. The various processes, Houdry, Thermofor, Cycloversion, and Fluid catalytic processes are discussed in some detail.

Hydroforming and Isoforming processes are included also in the chapter; also Polytreating and Isoversion methods. The Suspensoid catalytic process, developed and used so far by Imperial Oil, Ltd. of Canada's technologists, is not discussed. For a work of this scope the chapter on Synthetic Gasolines is rather comprehensive and discusses the numerous important phases of this engrossing subject. Hydrogenation of hydrocarbon materials such as coal and residual oils also receives attention, and the material on synthetic products other than gasoline is of double importance at present.

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NEWS

Venezuelan Refinery

Plans for a 35,000-bbl refinery and ocean tanker terminal in Venezuela to process its crude production there have been completed by Standard Oil Company of California. The new refinery will be situated near Lake Maracaibo and is scheduled for completion in 1950.

Crude oil will be supplied mainly from the Boscan field of Richmond Exploration Company, a California Standard subsidiary, through a new 18-in. pipe line being built by Richmond.

Distillation Research

Forty-one laboratories of 28 oil companies and three commercial laboratories are participating in a research program sponsored by the Natural Gasoline Association of America to determine if through minor changes in equipment and major revisions in technique, more accurate and duplicable results can be obtained with all low temperature distillation.

Houdriflow Unit

Tide Water Associated Oil Company is building a Houdriflow catalytic cracking unit at its Drumright, Oklahoma, refinery. The unit will have a rated capacity of 4500 bbl of charging stock per calendar day with provision for 50 per cent recycle. Process Engineers, Inc., of Dallas, is handling the construction, and Tide Water hopes to have the new unit operating sometime during the fourth quarter of 1949.

The Houdriflow process was described in the January 1949, issue of *The Petroleum Engineer, Refining and Gas Processing.*

Whiting Science Club

Chemists and engineers of the Standard Oil Company (Indiana) have formed a new organization, the Whiting Science club, designed to broaden the technical background of its 350 members.

At dinner meetings held five times per year in the new research laboratory, scientists from the laboratories and refinery at Whiting, Indiana, and the general office of the company in Chicago gather to hear addresses by eminent authorities in various scientific fields. The organization also sponsors lecture courses in such fields as petroleum technology.

Present officers of the club are Philip Hill, president, Howard Parker, vice president, and Marvin DenHerder, secretary-treasurer.

Two Natural Gasoline Plants For Benedum Field

Two natural gasoline and pressure maintenance plants will be built in the near future in the Benedum, Texas, field discovered in 1947 and already boasting six producing wells, says W. M. Griffith, vice president of Plymouth Oil Company. The total expenditure is expected to reach $12,000,000, it is stated. Hudson Engineering Company of Houston will build the Plymouth plant, to handle eventually 80,000,000 cu ft of gas; the Slick-Urschel Oil Company's unit will be built by Texas Natural Gasoline Corporation of San Antonio. Construction will begin about March, 1949, and the units are expected to be in operation by about November, 1949. El Paso Natural Gas Company will have completed a 20-in. gas line from Jal, New Mexico, to the field by the time the plants are operating. This company's lines go to California. The Santa Fe Railroad will lay a spur track from near Rankin or Texon to the field to haul in equipment, etc., and to ship plant products from the field.

Production of Fluorocarbons

The first commercial production of fluorocarbons was begun by Minnesota Mining and Manufacturing Company at St. Paul, where a new pilot plant has been put into operation recently. The fluorocarbons are analogous to hydrocarbons, being carbon chains in which part or all the hydrogen is replaced by fluorine in a manner similar to the chlorinated products which have been known for a long time.

Among the products now offered are saturated fluorocarbons, fluorinated ethers, and completely fluorinated tertiary amines. The price is $3.00 per lb. They are produced by a relatively inexpensive low-voltage electrolysis process, and it is expected that in approximately a year larger production on a semi-works basis will begin. The products are employed in a huge number of finished materials, such as plastics, anaesthetics, insecticides, lubricants, hydraulic fluids, fireproof materials, and other items.

Danciger District Office

Danciger Oil and Refining Company is establishing a district office in the Transit Tower Building at San Antonio, Texas. Edwin A. Taegel of San Antonio, formerly a consulting geologist, will be in charge of the geological department, and Jay Hausam, formerly associated with the company both at Tulsa and Fort Worth, is being transferred to San Antonio to supervise the land department.

New Process Company

A new service to the chemical industry and processing field has been promised with the organization of Process Industries Engineers, Inc., which recently opened offices at Pittsburgh, Pennsylvania. Wm. W. Calihan, R. R. Maccary, R. E. Nelson, and R. F. Fey are company officials.

The company announces its plan to integrate two complementary services: First, the sale of equipment of various nationally known manufacturers where engineered applications are satisfactory, and, second, the design and fabrication of equipment where special designs are necessary. The company's specialization is in the field of inter-related unit process operations, which include material storage, handling, fluid movement, mixing and agitation, reduction and separation.

Caltex Netherlands Refinery

The Caltex Petroleum Company recently bought at Pernis near Rotterdam, a site of considerable size on which to build a large oil refinery, reports the "Nautical Gazette." According to Cabinet Minister Dr. Van Schaik of the Netherlands, work will be confined to the refining of petroleum obtained from the Saudi Arabian area. The extent of the output may be estimated from the fact that every four days, on an average, a tanker is to be unloaded at the works. Construction on the new refinery facilities already has begun and will take about two years to complete. Caltex expects to attain an initial daily output of 20,000 bbl. Later the capacity is to be raised to 40,000 bbl.

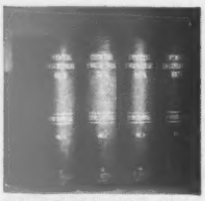
Colorado Oil Shale

Naval Oil Shale Reserves 1 and 3, Garfield County, Colorado, contain a "vast potential reserve of oil larger than hitherto believed present," the U. S. Geological Survey has reported.

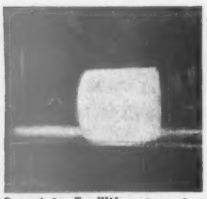
The study shows the geology of an area northwest of Rifle, Colorado, covering approximately 175 sq mi, of which about 85 sq mi is underlaid by oil shales having a total potential yield of about 40 billion bbl of oil.

A thinner rich unit within the same oil shale sequence ranges from 70 to 135 ft in thickness, yields an average of 25 to 30 gal of oil per ton, and has a total potential yield of about 10 billion bbl of oil. About one-half of the shale oil resources considered in the report lies in the naval reserves. The area covered by the map is only a small part of the total area underlaid by the oil shales of the Green River formation which is widespread in Colorado, Utah, and Wyoming.

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.



Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.



Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

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Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

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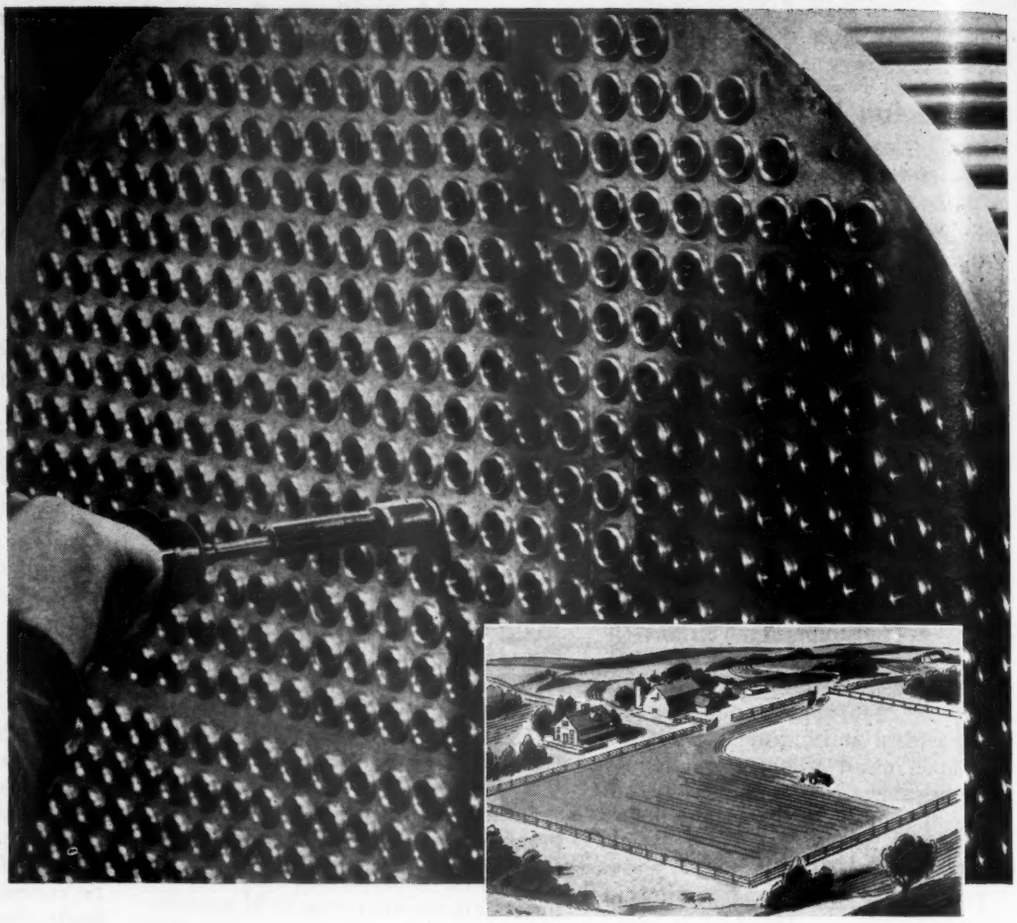

When an acre is small potatoes

ONE ACRE—43,560 square feet. It sounds like a lot of surface when talking about mowing a lawn. But it's "small potatoes" when you consider a recent Kellogg order for a quarter million square feet of heat exchanger surface—more than five acres. Another on the books for better than 200,000 square feet and yet another for 190,000 square feet.

That acre isn't so impressive now. But don't just consider the size of these orders. Think what orders of this magnitude imply.

Any group of heat exchangers for a normal refinery reaching such total transfer area would of necessity include all types for all refinery uses. Thus specialization as to size or application can't be the reason why Kellogg gets these tremendous orders. Price could be a dominant factor but here again the modern refiner knows that the real economy in heat exchangers is found in high performance and low maintenance.

No, it is a lot more basic than price or type specialization. We like to believe that these orders result from two things: The acceptance of The M. W. Kellogg Company as outstanding in the technical advancement of the science of heat exchange itself, and twenty-five years of experience in manufacturing techniques that give Kellogg heat exchangers an appreciable advantage in lower maintenance cost.

It is the continuing research into better methods of transferring heat and the continuous development of better manufacturing techniques that creates this overall acceptance of M. W. Kellogg products.

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PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

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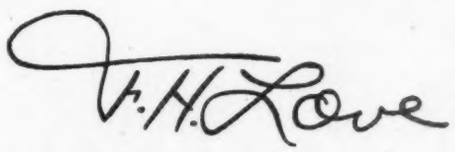
TRANSPORTATION PROGRESS

FOR many years *The Petroleum Engineer* has published annually in March a special pipe line number. Now that a specialized pipe line and marine transportation magazine is issued each month, this appellation is not entirely appropriate, so the current issue may be looked upon more in terms of an Annual. In it we attempt to accomplish in broader scope the same aim striven for monthly—the presentation of articles to keep the pipe line fraternity informed on the lastest practices in construction and operating methods, in addition to news.

In an effort to overtake the great demand for oil, gas, and gasoline transportation facilities, pipe line construction during 1948 attained an all-time high despite the difficulty in obtaining line pipe. With pipe more easily procurable during the current year, it is entirely reasonable to expect the 1949 construction program to surpass even that of 1948. The number and extent of projects already announced indicate this will be so.

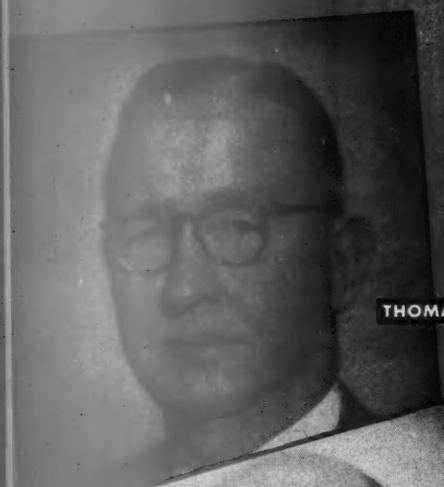
It is not surprising that activity of such proportions should result in the development of many new and worthwhile methods of procedure both with respect to construction of pipe lines and their operation. Insofar as possible these developments and practices are chronicled in the succeeding pages, their coverage including the various phases of pipe line laying, line maintenance, dispatching, communications, station design, metering, engine operation, the feasibility of manufacturing line pipe from special materials for special purposes, to mention some of the subjects in their general aspect.

We think it a privilege to be able to present such a comprehensive group of articles, and consider it an additional distinction that these articles should have been written exclusive for us by outstanding authorities in the pipe line industry.



Specialists In...

PIPE LINE



THOMAS R. JONES

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MAINTENANCE OF OIL PIPE LINES

A. M. HILL

EXCLUSIVE

THE nation's oil pipe lines, now a vital transportation facility, stem from a humble conception in 1865, when pioneering oil men and pipe line workers in a small Pennsylvania oil field battled with defiant teamsters to overcome the many obstacles encountered in laying the first oil pipe line. Constructed of 2-in. pipe, it extended from a well to a transportation center 6 miles distant. Previously, oil was hauled from well to shipping points by wagon. Thus, The Van Syckle Pipe Line, the nation's first successful oil artery, proved the efficiency of pipe lines by transporting oil in an amount equivalent to a daily horse-drawn haul of 300 teams, and broke the bottleneck of oil transportation. In a sense, this is typical of the present era because petroleum and its products are so essential to current modes of transportation and the American way of life that the consumption of crude oil exceeds 5,000,000 bbl daily.

Obviously, the numerous pipe line systems now serving the nation are the only means by which this volume of oil could be gathered in the producing areas, transported to refineries, and then distributed to consumers throughout the country. Several hundred trains of oil cars and thousands of trucks could not function to serve the nation as its pipe lines do.

Today the vast system of pipe lines, prime movers of petroleum and its products, serve all producing areas directly or indirectly by carrying and distributing crude oil, refined products, and natural gas, and provide unfailing service; however, in many instances the important function of the pipe line is not fully appreciated as their existence is recognized primarily by pumping stations, oil storage tanks, and natural gas compressor stations, which are often remotely located from towns and villages. It is interesting to note that these underground arteries carrying the vital cargo function so smoothly that they are unobserved by the layman, except when leaks or breaks occur.

The key to successful pipe line operations is the coordination between management, the pump station operating personnel, and line maintenance personnel.

The pump stations of a trunk line system are spaced at intervals of 40 to 80 or 100 miles, depending on the contour of the ground traversed by the pipe line or lines. Buildings at these stations house the pumping machinery and operating personnel, also the manifold, which consists of valves and piping to receive and relay the oil. Oil storage tanks are usually required in conjunction with station operations. Pump station personnel consists of a chief engineer and 5 to 20 men classified as engineers, oilers, gaugers, utility men, and laborers. Stations having a large number of engines and pumps require the greater number of men and the large stations employ a machinist full time to repair and maintain the pumping machinery.

The line maintenance crew usually consists of a foreman, a welder, truck driver, machine operator, and 10 to 15 men classified as pipeliners and/or laborers. The pipeliners are semi-skilled workmen, capable of performing numerous jobs in the maintenance of lines. Crews of this size with modern equipment are situated at towns 80 to 100 miles apart but in the proximity of the pipe line. Each crew maintains 80 to 150 miles of pipe line. The area management directs all operations from a central location conveniently situated adjacent to the pipe line. Direct telephone communication is maintained between the area office, pump stations, and maintenance crew headquarters.

Pump stations are the nerve center or control point for all operations within the area, in that the pumping operations are carefully observed by the station personnel through the use of gauges, meters, and other instruments, that measure the line pressures, rate of flow, and register other pertinent information. These instruments enable the station personnel to detect leaks and many other unusual conditions that occur in pipe line operations.

An appreciable drop in operating pressure indicates a leak either at the station or on the pipe line, consequently all unusual conditions are promptly checked and if it is determined that a leak has occurred it is the duty of the station personnel to contact immediately the line maintenance foreman and area management and advise them of conditions. The pumping units are immediately shut down, and may not resume operations until the leak has been found and repaired, or any other trouble affecting operations has been corrected. When leaks are reported some members of the maintenance crew immediately set out to patrol the pipe line and find the leak.

By experience, and careful observation of operating conditions, the station personnel can usually determine the nature of a leak and the approximate location where it may be found. With this information the maintenance foreman can make preparation to dispatch men, materials, and equipment to the point of the leak for making temporary or permanent repairs soon after it is found. Dependable communication is very essential in this phase of operations.

An emergency call during the night, especially in winter months, is very

THE AUTHOR

A. M. Hill, has been associated with welding and pipe line construction for over 29 years. His 26 years service with Stanolind Pipe Line Company comprises 4 years as welder, 10 years supervision of welding on line construction and maintenance, also the design, fabrication, and installation of manifold piping systems, 12 years as superintendent of line maintenance throughout Stanolind's system. He has invented and developed pipe line tools and equipment; also contributed to standardization of pipe line practices, particularly construction and maintenance.

unpleasant as the crew members must endure many hardships in cold weather when road and ground conditions are usually bad; furthermore, safety hazards are magnified by these conditions. Nevertheless the objective of a maintenance crew is to safeguard the public, also the landowners and the company's property. Insofar as possible, oil escaping from a leak is controlled so as to minimize the possibility of fire and other damage.

Time is the essence, and a concerted effort is made to complete the repair of leaks in the shortest time possible. This motive prevails throughout the pipe line industry, and rarely does a pipe line leak or a failure of machinery disrupt operations on a large scale.

The types of leaks usually encountered in pipe line operations and the conventional method of repair are outlined below. The sequence indicates relative frequency.

External Pit Leak

External pit leaks result from electro-chemical reaction of alkaline soils, salt water, and certain other elements of the soil. These eat away the steel in the walls of the pipe. Pit leaks usually occur on the bottom of a pipe line along the banks and in the bed of creeks and rivers, also sloughs and other low areas where the ground is alternately wet and dry; however, pit leaks may occur at any point on the pipe line.

Within the last decade extensive corrosion surveys by pipe line companies have disclosed valuable data, and from these surveys much progress has been made toward the control of corrosion.

It has been determined that normal stressing of the pipe causes the molecules of the steel to generate a flood of electrons or negative particles of electricity. These form static charges of electricity on the pipe line, and are discharged into the ground where the soil is damp. These are supplemented by stray electrical currents from power lines and other sources of direct current, which are grounded to the earth. These grounded currents travel on pipe lines with less resistance than through the ground, and corrosion is accelerated at locations where these currents discharge into damp earth.

At points where the pipe is not seriously corroded the pit leak is temporarily repaired by installing a circular steel patch with a special rubber gasket. These are compressed against the pipe with U-bolt clamps. The leak is permanently repaired by arc welding the circular steel patch to the pipe as soon as convenient. The clamps are removed and salvaged for use when other leaks occur, and the protective coatings on the exterior of the pipe are replaced to prevent other leaks.

In areas where the pipe is severely corroded and where pits have not penetrated the walls of the pipe, the pits may be repaired or filled by arc welding, but in extreme cases it is often necessary to replace sections of pipe. This necessitates taking the line out of service, draining the oil by use of portable pumping units preparatory to cutting the line, and installing the new section of pipe. Where a parallel line exists the defective line is emptied by transferring the oil into the other line. Block valves installed at strategic locations along the lines aid in draining for the replacement of pipe; however, some pipe line companies follow the practice of installing long semi-circular housings, known as half soles, at locations where corrosion is severe. These are arc welded to the pipe.

When leaks develop at creeks, rivers, highways, and railroads, it is the general practice of most companies to replace the defective or corroded pipe. These jobs usually entail large expenditures, as a single leak may involve excavating and backfilling several hundred or even thousands of cubic yards of earth. Bulldozer tractors and dragline machines are very essential in conjunction with pipe replacements at such locations.

Bank erosion at stream crossings presents many complex problems and sometimes necessitates replacing the pipe or altering the position of the line to correct the trouble.

Collar Leak

Collar leaks frequently occur in the couplings of a screw joint pipe line due to various conditions such as defective threads, poor make-up of joint, excessive tension due to contraction of the line, and mechanical stresses from inferior bends placed in the line to make it follow the contour of the ground.

Repairs are usually made by arc welding the coupling, but in extreme cases a special collar welding sleeve is installed over the coupling and arc welded to the line. Welding a leaky coupling is hazardous, because heat generated by welding expands the coupling and increases the leak. Fires and serious accidents have occurred in making this type of repair, and safety precautions are necessary. The possibility of fires and accidents is minimized by the use of a special tool known as a collar welding jig. It consists of housings and slips that grip the pipe, and turnbuckles that are tightened to relieve the tension on coupling to prevent the line from pulling apart while the welding operation is in progress. Hazards are further minimized by reducing the line pressure to about 200 psi at the location where welding work is being performed.

Coupling Failure

The thread and coupled lines are subject to failure due to seasonal changes of atmospheric temperatures. During the winter months frost penetrates deep into the ground and sets up high stresses in the pipe, which may cause the line to pull apart. Repairs are made by installing a new section of pipe.

Split Joint

Occasionally the longitudinal seam in lapweld or electric welded pipe is weak due to poor fusion of the metal. Pulsations and pressure surges caused by the large pumps are characteristic of pipe lines. The surges flex and stress the pipe and cause failures. These line failures are repaired by replacing the entire joint of pipe; this eliminates the possibility of subsequent failures in the same area.

Internal Pit Leak

Oils produced in certain localities contain a high percentage of hydrogen sulphide, and the sediment from this chemical attacks and eats away the wall of the pipe from the inside. Leaks of this type are usually confined to the lines in the area where the oil is produced, and the possibility of internal leaks is minimized when this type of crude is mixed with non-hydrogen sulphide crudes.

Repairs may be made by arc welding a patch to the outside surface of the pipe, however, in extreme cases it is necessary to replace the sections of pipe affected by internal corrosion.

Accidental Punctures

Leaks caused by accidental punctures have become rather frequent in recent years due to the wide use of power machinery as employed to dig slush pits for oil well drilling rigs, construction machinery engaged in laying new pipe lines, excavating machines used on road building projects, also underground telephone cable laying machines. The seriousness of these accidents is emphasized by several fatalities that have occurred as the result of the machinery puncturing high pressure oil lines, gas lines, or petroleum products lines. The gaseous vapors that escape from the pipe line have been ignited by the exhaust flame from the internal-combustion engines, and resultant fires in many instances have proved fatal.

Pipe line maintenance crews have

taken progressive steps to minimize these accidents through close observation of activities in general. When construction projects of other companies or individuals are noted adjacent to the pipe line right-of-way, the persons in charge are immediately contacted and informed of the location of the pipe lines and the hazards of operating machinery in a manner that would puncture the line. Exact location of the line is marked as a further precaution, nevertheless warnings have been disregarded. It is rather difficult to impress these hazards on the minds of persons not familiar with pipe line operations.

When such failures occur pipe in the line is usually damaged beyond repair and must be replaced.

Weld Failure

Pipe lines constructed of welded joints are very dependable although in some instances defective welds may not be detected during the construction period, but fail after the line is placed in operation. It is not practical to repair a defective weld—the common practice is to remove the weld and install a new section of pipe, minimum length 3 ft.

LINE PIPE OUTPUT RISES

Production of line pipe reached 2,221,084 tons last year, compared with 1,200,000 tons in 1947, the Office of Industry Cooperation of the Department of Commerce reports. A still greater increase is anticipated this year with estimated production of 2,553,517 tons or 246 per cent more than the prewar average. This would still fall short of the industry's needs, the OIC said.

All pipe line leaks are accompanied by the loss of oil, however, the amounts vary with the type of leak. The larger losses are characteristic of both the coupling failure and the split joint; furthermore, it is not possible to anticipate these failures or exercise preventive measures.

Wherever possible oil from large leaks is trapped in ravines and other water courses by building temporary dams. Portable pumps are then connected to pick up the oil and pump it back into the pipe line. This avoids extensive property damage.

In addition to replacing sections of defective pipe, as referred to above, it is frequently necessary to relocate certain sections of a line to conform with highway construction and improvement, railroad trackage alterations, power dams, irrigation projects, and private construction.

Although draining and cutting a pipe line is still a major operation, this work has been greatly simplified by the use of a modern pipe line tapping machine. With this machine and associated equipment it is possible to make an opening in the pipe line at any location. A special tapping nipple is arc welded to the line; it accommodates a conventional gate valve onto which the tapping machine is mounted for drilling the opening into the line. This facilitates connecting a portable pumping unit which is used to drain or transfer the oil from one line into another. Upon completion of the draining operation the tapping nipple is closed by a special plug installed with the tapping machine. This permits removal of the gate valves used in conjunction with pumping unit, and makes the pipe line safe for future operation. It is desirable to remove gate valves because there is a possibility of failure of the valve due to thermal expansion of the oil trapped within the valve body. Tapping nipples are available for future use by reinstalling valve and removing the special plug with the tapping machine.

After oil in the pipe line has been transferred or otherwise drained the initial cut in the line must be made with a mechanical pipe cutter, and safety precautions must be observed when subsequent cuts are made with an oxy-acetylene torch in preparation for making a tie-in weld, because the gaseous vapors may be ignited by the cutting torch and cause explosions and fires. It is very essential to seal off the open ends of the pipe line immediately after the initial cut has been made; damp earth and various types of mechanical plugs are used for this purpose.

These potential fire hazards are always present when a line is drained because air must be admitted to the line as oil is removed. Oil draining from the points of higher elevation accumulates in the low places, such as creek and river crossings; consequently, a vacuum is created and when the line has been emptied and cut mechanically a large volume of air usually enters the line and mingles with the petroleum vapors, thus a combustible mixture is formed and, should it be ignited, an explosion may release a large quantity of oil held in the line by vacuum at the crest of hills.

Use of Arc Welding

The engine driven arc welding unit and the oxy-acetylene cutting and welding outfit usually transported by a light truck are indispensable and commonplace in the repair and maintenance of pipe lines, and therefore safe work procedures must be exercised by the maintenance foreman and other supervisors in planning and administering welding work to eliminate the possibility of serious accidents, explosions, and fires. Realizing the magnitude of potential accidents, which are characteristic of welding in conjunction with repair work on pipe lines, Stanolind Pipe Line Company and other companies follow a policy whereby no welding shall be performed on lines in service until a formal written request is made by the maintenance foreman or other supervisor in charge of the job for permission to do welding work. This request describes the nature of the work and procedure to be followed. Before approval is granted the operating superintendent and the chief oil dispatcher in the general office have been assured that all hazards have been considered and the proper safety precautions taken to prevent accidents; in fact, the jobs are planned around safe and proved work methods. This policy has been in force for almost 20 years, and has been very effective in reducing accidents and subsequent injury to employes, as well as minimizing property damages.

In furtherance of this policy a constructive training program is carried on by the management and safety department to teach maintenance foremen, chief engineers, and field employes safe work practices and efficient management. Monthly safety meetings are held at each pump station and maintenance crew headquarters. Area safety engineers assist with training new employes in this safety work, which is a part of their basic training for various job classifications. Welders, truck drivers, and machine operators are given special training on safety in their particular lines of duty. Welders are required to pass a welding qualification test before being approved for welding work on pipe line repairs. The fruits of this program are realized in all pipe line operations, in that the employes are equipped with essential knowledge that is applied in various ways.

Crew Duties Many

Although the principal duty of a pipe line maintenance crew is the repair of leaks on pipe lines and at the pump stations, the crew is trained and equipped to perform many other duties related to pipe line operations. These include installation of new lines and piping facilities at pump stations, and the alteration of lines, manifolds, and tank connections; connecting newly laid lines with existing facilities; backfilling washouts along the right-of-way; inspection and repair of bank erosion at creek and river crossings, also highway and road

crossings; inserting and removing scrapers (internal cleaning tools), which are run through the pipe line to remove accumulations of paraffin and sediment from the inside of the pipe. Also, the painting and maintenance of mile posts and other markers, which are installed at various locations to identify the lines. In the growing season weeds and underbrush are cleared from the right-of-way to aid aerial patrolmen in locating leaks. Access roads to the pipe line right-of-way in remote areas are also maintained by the crew.

While on routine duty the crew is on the alert for any conditions that might be the cause of a leak, and corrective measures are promptly taken.

Significant Developments

Current practices commonplace throughout the pipe line industry are evolutionary, although much progress has been made through the exchange of constructive ideas, application of sound engineering practices, development of special tools and equipment, and wide use of mechanized tools. The era of greatest progress has taken place within the last three decades. The most significant developments are exemplified in the following resume of pipe line activities:

(a). Engineering technique has been applied in various ways to improve pipe lines through development of high strength seamless pipe, adoption of welding, development of pipe line coating materials, and the application of cathodic protection for the control of corrosion.

(b). Development of machines such as sideboom tractors, bulldozers, ditching machines, draglines, pipe cleaning machines, coating and wrapping machines, and heavy duty trucks, has gradually improved pipe line construction methods and, within the last decade, there has been a definite trend toward large diameter pipe lines, (16 to 30 in. in diam). With modern engineering technique and construction methods it is possible to construct a 30-in. line with progress equal to that formerly made in laying 12-in. pipe, and modern construction procedures take into consideration all minor details that might have a bearing on the operation or maintenance of the line.

(c). The right-of-way is carefully selected, and any conditions that might involve altering or relocating the lines are avoided.

(d). Furthermore, these developments have made it possible to modernize pipe lines laid with screw joints. Pipe in such lines frequently is taken up, cleaned, reconditioned by spot welding the pits, and relaid as a welded coated line, which may be operated at higher pressures without troublesome leaks.

(e). From a maintenance standpoint the major problems brought about by the extensive use of large diameter pipe is the maintenance of backfill, and the draining of the line when failures occur, however, with modern equipment such as power loaders, dump trucks, and large capacity portable pumping units these problems are being overcome without difficulty.

In further analyzing the above, it is obvious that welding, although humbly conceived, has won a position high in the pipe line and petroleum industry. The oxy-acetylene weld came into use on the pipe line in 1922, however, it was not generally accepted until about 1930. In the meantime it proved its value by increasing the strength of the pipe as compared from about 40 to 80 or 90 per cent of the strength of the pipe as compared with the thread and coupled pipe joint. In 1930 the field of welding was greatly extended by improvements in arc-welding machines, development of shielded electrodes, and better welding technique. Thus the strength of the pipe joint was further increased so that it now equals the ultimate strength of all common grades of line pipe and, with modern welding practices and technique, the problems in pipe line repair work, oil tank erection and repair, and fabrication of manifold piping systems, are overcome without difficulty; in fact, the oil industry proved welding so thoroughly that it is now widely used in all manufacturing plants where steel and other metals are fabricated. Semi- and full-automatic welding machines effect further economies in the fabrication of steel products.

The petroleum industry also served as a proving ground for the modern truck. Today trucks equipped with special beds and other attachments such as winches and booms are the prime movers, and capable of performing many of the pulling, hoisting, and carrying operations formerly done by hand.

Innumerable other machines have been developed and improved to facilitate pipe line maintenance and construction work. New and improved machines are being introduced that will provide greater efficiency in the pipe line industry. Of particular importance is the tapping machine. Although tapping machines were invented some 50 years ago, they did not come into general use on the pipe line until about 1935, when a new type of machine was developed that made use of a special tapping nipple and plug. The basic idea of the modern tapping machine is the method of controlling the boring bar when inserting or removing through the gate valve against pressure, and by a unique method of using the machine and a special plug to close the opening into the pipe line so that the gate valves used in the tapping operation can be removed. The modern machine has automatic feed mechanism, which greatly simplifies tapping lines.

The tapping machine is a standard item in Stanolind's maintenance crew equipment. It can best be appraised by its effectiveness in conserving large quantities of oil that otherwise would be lost. Before tapping machines and portable pumping units came into use it was the customary practice to cut a pipe line near a ravine or creek where the oil could be trapped and disposed of by burning.

Now under development is a companion machine that will be used to shut off the flow in the large diameter pipe line at a desired location after the pumping station has been shut down. It will be inserted through the tapping nipple and thus save the time of draining long sections of line where necessary to replace pipe.

A new air-driven pipe cutter is also being developed. It is a complete departure from the conventional design and should greatly simplify the laborious task of cutting the pipe line manually.

Improvements in cleaning machines and pipe beveling machines also promise new economies in the maintenance field. Portable air compressors and air tools are coming into use for pipe line maintenance work. Paving breakers and air spades are very effective as demolition tools in making excavations where rock, hard or frozen ground is encountered. Air drills, impact wrenches, and other air tools are great time savers in conjunction with pipe line work.

Conclusion

In conclusion, it may be said that the progressive spirit that prevails throughout the pipe line industry has resulted in pipe line transportation rates staying low while other rates have risen substantially, and the pipe line workers have been rewarded with improved working conditions, higher wages, and less physical effort in performing the work.

The era of pick and shovel, hammer and tongs, is in the memory of thousands of men still associated with pipe line activities. That rigorous period demanded strength and endurance on the part of the worker. ***

Stock Accounting in Products Pipe Line

F. W. MANN*

EXCLUSIVE

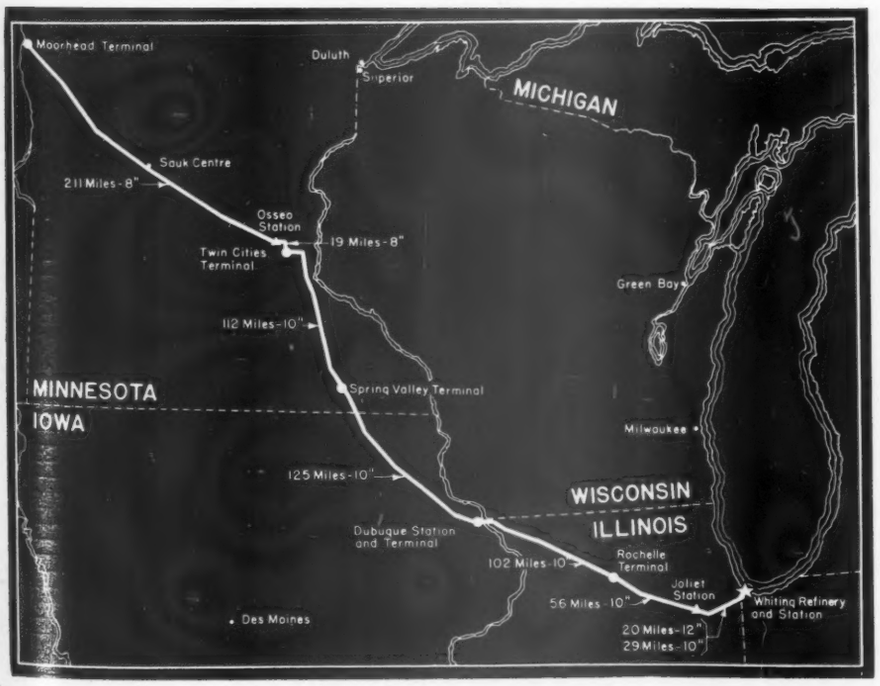
IN February of 1947, Standard Oil Company (Indiana) placed in operation its Northwestern products pipe line covering a distance of about 675 miles from Whiting, Indiana to Moorhead, Minnesota. Storage facilities are situated along the pipe line at Rochelle, Illinois; Dubuque, Iowa; Spring Valley, Minnesota; Twin Cities (Minneapolis-Saint Paul); and Moorhead, Minnesota. Pumping stations are at Whiting, Indiana; Joliet, Illinois; Dubuque, Iowa; and Osseo, Minnesota.

The line itself grades in size from mixed 10-in. and 12-in. from the Whiting refinery to the Joliet station, 10-in. to the Twin Cities terminal, and 8-in. on north into the Moorhead terminal. The initial station at Whiting is electric powered with two 500-hp motors and one 250-hp motor driving three direct-connected Bingham centrifugal units, which in series are capable of delivering 3000 bbl per hour at 550 psi. The Joliet station is equipped with three 650-hp engines driving, through gear increasers, centrifugal pumps capable of delivering to Dubuque 1370 bbl per hour at 1200 psi. The Dubuque station is identical in equipment to the Joliet station and is capable of delivering 1170 bbl per hr to Twin Cities and Osseo at 1200 psi. The final station at Osseo, Minnesota, is equiped with two 240-hp diesel engines driving, through gear increasers, centrifugal units capable of delivering 600 bbl per hr at 1000 psi. The pumping rates quoted are on the basis of a gasoline line fill. The Twin Cities terminal is equipped either to bypass a percentage of the stream or pump out of tankage a short distance to the Osseo station.

At all points of input and output, the products are measured by positive displacement meters. Almost all meters used are of the rotary blade type and are calibrated to an accuracy of approximately 1/10 of 1 per cent.

*Assistant to the superintendent, Products Pipe Line Department, Standard Oil Company (Indiana).

FIG. 1.



At present, nine products are handled through this line, which are:

Aviation gasoline, premium grade gasoline, housebrand gasoline, unleaded gasoline, tractor fuel, kerosine, heater oil, furnace oil, and high speed diesel fuel.

The products are batched in sequence with no attempt to segregate, excepting the occasional use of a "flag" or "buffer batch," to prevent contamination of unleaded product with leaded product. The sequence of batches established is instrumental in minimizing commingling or inter-batch mixture and preventing commingling of high flash and low flash products. Excessive economic loss through product upgrading from inter-batch mixing is also avoided through adherence to the established sequence. A minimum batch size for each product is also established to assure that the inter-batch commingling may be cut into either one or both of the adjacent batches without impairing specification of either product.

The sequence used in Standard's Northwestern product line is a follows:

Cycle	*Product*
Oil	—Kerosine
	Heater oil
	High speed diesel fuel
	Furnace oil
Gasoline	—Tractor fuel
	Unleaded gasoline
	Housebrand gasoline
	Premium grade gasoline
	Aviation gasoline
	Premium grade gasoline
	Housebrand gasoline
	Unleaded gasoline (Flag, if requirements do not permit two batches per cycle)
	Tractor fuel

Current delivery rates average 33,000 bbl per day out of the Whiting refinery in the summer season and 30,000 bbl per day in the winter season with take-offs at approximately:

14 per cent at Rochelle
12 per cent at Dubuque
14 per cent at Spring Valley
32 per cent at Twin Cities
28 per cent at Moorhead

The lower capacity in the winter

season is due to a much greater proportion of oil batches to gasolines and the resultant increase in line friction loss.

The line is operated as a plant facility connecting the refinery supply to the distribution terminals. The size of batches and batch arrival dates are prepared by the dispatching supervisor in Chicago, who correlates the product movements to the terminal requirements and refinery available supply. The batching schedules prepared by the dispatching supervisor and his staff are forwarded to the operating personnel on the line.

Physical control of the product movement is maintained by the line's chief dispatcher-deliveryman at the Rochelle terminal, who endeavors to regulate line pumping rates and batch arrivals at terminals to coincide with the batching schedule. Terminal storage receipts are controlled by pipe line deliverymen, who are responsible for regulating the products into the proper tanks. A terminal crew performs the functions of loading products into tank cars and tank trucks.

Stock Accounting

Pipe line operation is dependable and normally assures a continuous product flow, which eliminates the necessity for expensive return of empty containers. Some advantages of product movement by "package" means, such as tank cars, tank trucks, and lake tankers, are sacrificed in pipe line operation as, for example, a temporarily unneeded batch of product cannot be run off on a railroad siding and held until it is wanted, nor can it be redirected, usually, to some other point. Neither is it possible to keep the many batches of products in the line at the same time from commingling to some extent, although under normal operations, this does not impair the quality of products. Further, the pipe line is constructed just below the surface of the ground for a distance of 675 miles, every foot of which is exposed to the possibility of developing a leak through corrosion, accident, or other means.

For two reasons, (1) possible loss from leaks and (2) inter-batch commingling, it is not possible to expect shipments into terminals to coincide with refinery station input. As a matter of fact, the volumes involved are large, so that a pipe line loss of a fracton of 1 per cent would amount to a considerable sum of money over a year's operation. For this reason, it is necessary that an efficient method of accounting be maintained for stock handled.

The method of accounting for stock is not unique, but has evolved both from industry practice and company experience with two products lines constructed earlier. The system, as is common in product line operation, revolves around treatment of a batch of product at the line origin as an accounting unit and continuously reporting receipts and making the necessary adjustments for commingling loss or gain to the batch at each successive terminal until the entire batch is completely delivered into terminal storage. The final terminal receiving a portion of the particular batch of product will, under this system, have accumulated the reports of all previous points and may compute the overall receipts of the batch immediately after the batch has been completely delivered.

Every delivery of a batch from or to the pipe line is reported on a "Batch Report" form, shown in Fig. 2. To discuss the form used briefly before entering into detailed explanation:

Lines 9 to 24 in the lower left hand portion of the form are used for recording the product measurements and data concerning tests necessary to correct the observed meterings for meter slippage and wear.

In the space at the lower right hand corner of the form are recorded observed data to correct product volumes

FIG. 2.

FORM P-1 REV 5-46

STANDARD OIL COMPANY (INDIANA)
PIPE LINE DEPARTMENT

SERIAL NO. 248

BATCH REPORT

BATCH NO. 51N BRAND Red Crown ESTIMATED QUANTITY 36,000 BARRELS

LOCATION Moorhead Terminal DATE December 19, 1948 GRAVITY 63.3

	BARRELS		GALLONS	
	GROSS DELIVERY UNADJUSTED	NET DELIVERY ADJUSTED TO 60°	GROSS DELIVERY UNADJUSTED	NET DELIVERY ADJUSTED TO 60°
1. ORIGINAL BILLING OR BILLING AFTER ADJUSTING HEADS, TAILS AND FLAGS	143,252.08	144,051.35	6,016,588	6,050,284
2. ADD TO ORIGINAL BILLING 12.25 % OF Blue Crown FLAG NO. B-3N	159.25	160.27	6,689	6,731
3. ADD TO ORIGINAL BILLING % OF FLAG NO.				
4. R.C. #B-3N to R.C. #51N OBS'D. BBLS. 83.09 BBLS. @ 60° 84.96 METER CORR.				
5. W.C. #29N to R.C. #51N (Color Cut -) OBS'D BBLS. 50.00 BBLS. @ 60° METER CORR.	50.67	51.42	2,128	2,160
6. R.C. #51N to W.C. #29N (Estimated) OBS'D BBLS. 50.00 BBLS. @ 60° METER CORR.	50.67	51.42	2,128	2,160
7. OBS'D BBLS. BBLS. @ 60° METER CORR.				
8. BILLING AFTER ADJUSTING HEADS, TAILS AND FLAGS Final Billing	143,411.33	144,211.62	6,023,277	6,057,015
9. RECEIVED AT Rochelle, Dubuque, Spring Valley, Twin Cities	106,102.36	107,270.19	4,456,299	4,505,348

DATE 1948	TIME	METER & TEMP. READINGS READ BY	CHECKED BY	RUN	LINE FLUSH	METER READING BARRELS (42 GALLONS) METER NO. 1	METER NO. 2	METER NO. 3	METER NO.
12/19	1:00P	AWS		END	37	1592040.00	1877710.00	1648088.00	
12/15	12:45P	RDP		START	38	1575120.00	1858750.00	1648088.00	
10. TOTAL DELIVERY BY METER						16920.00	18960.00	None	
11. TOTAL DELIVERY INTO PIPE LINE (METER CORRECTED)									
12. TOTAL DELIVERY INTO STORAGE TANK (METER CORRECTED)						17043.52	19214.06		
13. TOTAL LOSS OR GAIN									

	BARRELS		GALLONS	
	GROSS DELIVERY UNADJUSTED	NET DELIVERY ADJUSTED TO 60°	GROSS DELIVERY UNADJUSTED	NET DELIVERY ADJUSTED TO 60°
12. TOTAL DELIVERY INTO STORAGE TANK (METER CORRECTED)	36,257.58	36,794.19	1,522,818	1,545,356
13. TOTAL LOSS OR GAIN	Loss 1,051.39	Loss 150.24	Loss 44,160	Loss 6,311

RECORD OF METER TESTS	METER NO. 1 TEST NO. 1	METER NO. 1 TEST NO. 2	METER NO. 2 TEST NO. 1	METER NO. 2 TEST NO. 2	METER NO. 3 TEST NO.	METER NO. 3 TEST NO.
14. FINAL METER READING	85071.451	85094.662	66489.531	66516.535		
15. INITIAL METER READING	85056.550	85079.737	66474.700	66501.707		
16. REGISTRATION BY METER	14.901	14.925	14.831	14.828		
17. TANK DEL. AT REG. TEMP	15.008	15.036	15.029	15.027		
18. TANK DEL. ADJ. TO REG. TEMP.	15.008	15.036	15.029	15.027		
19. ELAPSED TIME OF TEST	3:34	3:34	3:34	3:34		
20. METER FACTOR	1.00718	1.00743	1.01335	1.01342		
21. CORRECTION FACTOR		1.0073		1.01344		

	METER NO.	TEST NO.	METER NO.	TEST NO.
	TEST NO.	TEST NO.	TEST NO.	TEST NO.
22. TEMPERATURE OF REGISTRATION	36	TANK TEMPERATURE	36	
23. NORMAL RATE OF FLOW	248 BBLS. PER HOUR	TEST RATE OF FLOW	250	BBLS. PER HOUR
24. NORMAL PRESSURE	5#	TEST PRESSURE	5#	

REMARKS

SUMMARY OF HOURLY METER TEMP. READINGS			
BBLS. RUN METER UNADJ.	TEMP.	TEMP. CORR. FACTOR	BARRELS RUN ADJUSTED TO 60°
84.97	36	1.01514	8,627.85
2,273	37	1.01147	2,629.81
3110	38	1.01041	3,153.85
25.			
26. WEIGHTED AVERAGE TEMP. CORR. FACTOR			

ABOVE TEST MADE BY A. W. Schluender WITNESSED BY K. Littlefield

RECEIPT COMPUTATIONS CHECKED BY

A. W. Schluender — REPORT PREPARED BY
O. F. Reed — CHECKED BY
K. L. Emery

to a standard temperature of 60 F, which is used throughout the line.

In the upper left hand half of the form, Lines 2 to 7 are used to record losses and gains to the batch unit through commingling between the adjacent batches, and gains from buffer batches.

Finally, in the upper right hand corner of the form, Lines 1 to 13, the data recorded in the other portions of the form are tabulated to arrive at the true billing of the product batch.

Meter Observations

At the time a batch is started into the pipe line at the Whiting refinery pump station and also at the time the same batch is switched into the terminal tank for the batch, every meter at the station and terminal is read. At the end of the run in that batch, all meters are again read. These readings are taken by two employees to assist in preventing errors. These data are recorded on Line 9. The observed meterings, however, cannot be expected to be correct due to the various rates of slippage and wear in the meters between the various products. At a point usually in the center of each batch, the meters are calibrated or proved for the particular product pumped. These tests are made in conformance with the ASME-API Positive Displacement Meter Calibration Code (Tentative).

To test a meter, deliveries are made to an accurately calibrated prover tank generally large enough to contain the maximum flow through the meter for a period of approximately two minutes. The observed metered amount is divided by the actual content of the prover tank to arrive at the meter correction factor. Tests are made until two successive tests agree within 0.0005 in the meter factor. When two successive tests agree within this range the average of the two factors is applied to the observed meterings (Line 10) to arrive at the correct meter volumes, which are entered in the case of the originating station on Line 11 and in the case of the terminal on Line 12 of the form.

Some further considerations in performing the tests include: (1) additional testing of the meter during large batches to compensate for meter wear and (2) regulation of test deliveries to the prover tank so as to coincide with line operating conditions, particularly with respect to rate of flow, meter case pressure, and line temperature. The operator notes and records this information on Lines 22 to 24 of the form.

The South Central Regional meeting of the National Association of Corrosion Engineers will be held at the Adolphus Hotel, Dallas, Texas, October 3 and 4. G. R. Olson, United Gas Pipe Line Company, Shreveport, Louisiana, is chairman of arrangements.

Temperature Adjustments

The temperature of the batch is observed at the start and end of the run and also observed hourly during its passage. At the same time the hourly temperature observations are made, meter readings are taken for dispatching check purposes. From this information, the amount of the batch received for each whole degree of temperature is recorded in the "Summary of Hourly Meter Recordings" at the lower right hand corner of the form. The volume for each reading is then adjusted to 60 F by the use of National Bureau of Standard's Circular C-410 correction factors. The summation of the volumes at 60 F, divided by the summation of the observed volumes provide a weighted temperature correction factor, which is then applied against corrected meterings on Lines 11 and 12 and billing adjustments on Lines 2 to 7 arrive at the Standardized and correct volumes.

Batch Adjustment

As previously stated, a sequence in which products are pumped is so arranged that a minimum amount of commingling will occur between batches and, in addition, minimum batch sizes are established to assure that commingling may be cut into either one, or the other, or both adjacent batches without impairing the specifications of either product. At one point in the sequence, however, the demand for the particular product (unleaded gasoline) is not sufficient for batching twice in every cycle as required by the sequence and the other adjacent products, housebrand gasoline and tractor fuel, cannot be run together without impairing specifications. Tractor fuel is too low a grade of product to be cut into housebrand and no housebrand is permitted in tractor fuel, as the latter is an unleaded product. Consequently, it is necessary to run a flag of unleaded gasoline between the other two products when a regular batch of unleaded gasoline is not required for shipment. This flag is made large enough to cover a little more than the usual commingling with the adjacent batches and is wholly absorbed by the time both batches are received into storage.

In both cases, stock is added to or deducted from the original batch, depending on where the two batches are separated or "cut" into separate tankage. To be able to account for either batch and to assure that specifications of either batch will not be impaired, it is necessary to make an estimate of how much of each product is present in the mixture on each side of the "cut point." Except in cases where adjacent batches do not vary appreciably in specific gravity and cuts are made by color change, the proportions of each product at a point in the mixture may be estimated very closely on the basis of change in specific gravity.

At intervals of usually 10 bbl during the batch change, readings are taken by a hydrometer graduated in degrees API. This information is noted on a special report form "Report of Batch Change," which is shown in Fig. 3, together with a notation of the cut point. Specific gravities at 60 F are then calculated for each increment of mixture and, using a specific gravity of each product as received by the pipe line, a percentage of change is calculated, which is then multiplied by the increment in barrels to give the amount of tail product per increment. Summing up on each side of the cut point, the actual proportions are obtained to debit or credit the adjoining batches.

In the only case where a color cut may be required (between premium grade and housebrand gasolines) the cut is made as closely as possible to the point where the mixture proportions are equal. Generally it is not necessary to adjust the batch size in this case. The information thus gained from the Batch Change Reports at the head and tail of the primary batch may now be recorded on the Batch Report, Lines 4 to 6.

Flags are handled in the same manner, except a terminal withdrawing a portion of the pure flag that has not been commingled, will note the amount of pure flag plus the calculated commingled portion as heads or tails. The final terminal will record on Line 2 the total receipts of the flag into the batch at all terminals as a percentage of the flag injected at the originating station.

Billing

Thus far has been accumulated considerable information that needs correlation. Directing our attention to the billing column in the upper right hand corner of the form and summarizing.

Line 1 is used for recording the actual metered size of the batch immediately prior to arrival at the terminal, including the original billing at the Whiting pump station, plus any adjustment necessary for heads, tails, or flag at all upstream terminals.

Lines 2 and 3 provide for recording of the meter-corrected amount of flag

cut into the primary batch and which must be added to the batch billing shown on Line 1.

Lines 4, 5, 6, and 7 show the meter-corrected amounts of adjacent products to be added to and the primary product to be subtracted from the batch billing shown on Line 1.

Line 8 shows the summation of Lines 1 to 7 and is a true status of the batch as received at the terminal. In the case of the far terminal at Moorhead, this line will show the final billing of the batch.

Line 9 is the actual meter-corrected receipts at the upstream terminals that have withdrawn product.

Line 11 is used only by the Whiting refinery pump station for computing the original billing.

Line 12 shows the actual meter-corrected receipts into the terminal reporting.

Line 13 shows the final computation of overall loss or gain on the batch and is used only by the far terminal usually at Moorhead. Moorhead's actual receipts shown on Line 12 plus the upstream terminals' receipts shown on Line 9 is subtracted from the final adjusted billing to give the actual losses or gains on the batch.

Use and Distribution

After the batch is started into the pipe line at the Whiting refinery pump station, the operator at the point immediately prepares the initial report and distributes it to the pipe line deliveryman at the next terminal downstream, the terminal staff at that point, the dispatching supervisor, who rechecks it for errors, to the supervisor in charge of pipe line accounting, and to the refinery. If checking indicates no corrections are necessary, the billing is accepted.

The next terminal, Rochelle, receives its allocated portion of the batch and prepares its report by using Whiting station's initial billing on Line 1 of the report, making the necessary adjustments to this billing to account for heads, tails, or flags, and notes its own receipts on Line 12 of the form. Rochelle immediately distributes its report as does the Whiting station, except that the refinery does not require a copy of the report.

Following the batch on downstream, Dubuque, the next terminal, prepares its report using Rochelle's adjusted billing if one has been made. In the case a "heart-cut" was made at Rochele and no mixture taken-off, the original billing at Whiting would be carried by Dubuque on Line 1 of its report. Dubuque notes its own receipts on Line 12 of the form and the receipts of Rochelle on Line 9. Note that the billing is not adjusted for terminal receipts. Dubuque terminal distributes its report as does Rochelle, except that it also furnishes a copy to Rochelle, that point being the location of the chief-dispatcher-deliveryman.

The procedure at Spring Valley and Twin Cities is identical to that at Dubuque, the batch billing being continuously adjusted for commingling and flag as it moves by each point. The previous terminal's receipts are accumulated on Line 9 of the form at each terminal.

Finally, after about 20 days in the pipe line, the batch is completed into the last terminal, Moorhead, which point completes its report in the same manner as the preceding terminals, excepting that it also computes the final overall loss and gain, and records on Line 13 of the form.

The supervisor of pipe line accounting gives credit for the movement of product to each terminal on the basis of terminal receipts and records losses or gains, completing the accounting transactions on the particular batch.

The results obtained from this method of accounting have been unusually good. The information flows with the batch and the accounting is completed almost with the batch. Prompt receipt of this information is quite valuable in the interpretation and elimination of abnormal line operation conditions and best of all, for the line operators who are proud of their work, it shows the pipe line can be operated like a precision instrument.

The overall pipe line loss for the year 1948 was .014 per cent of the year's pumpings, and no monthly variation of loss or gain exceeded 2/10 of 1 per cent. This is considered ample justification for the procedure.

* * *

FIG. 3.

STANDARD OIL COMPANY - PIPELINE DEPARTMENT
BATCH CHANGE REPORT
Blue Crown Grav. API 62.3 Spec 7301

Terminal Moorhead — TEMP. 36° — Date Dec. 15, 1948
From Power Fuel 40N To Blue Crown Flag B-3N — From Blue Crown Flag B-3N To Red Crown 51N
API 48.5 Spec. 7861 Const. .0560 — API 63.1 Spec. 7271 Const. .0030
From Blue Crown B-3N To Power Fuel 40N Bbls. 603.57 — From Blue Crown B-3N To Red Crown 51N Bbls. 83.99
From ____ To ____ Bbls. ____ — From ____ To ____ Bbls. ____

Meter Read.	Obs. Gty	True Gty	Spec. Gty	o/o	Bbls.	Meter Read.	Obs. Gty	True Gty	Spec. Gty	o/o	Bbls
1857970	46.6	48.6	7857	0.7	.07	70	59.6	62.2	7305	99.3	9.93
80	46.7	48.7	7852	1.6	.16	80	59.7	62.3	7301	100.0	10.00
90	46.8	48.8	7848	2.3	.23	1858740	59.7	62.3	7301	100.0	10.00
1858000	46.9	48.9	7844	3.0	.30	Cut 50	59.7	62.3	7301	100.0	10.00
10	47.1	49.1	7835	4.6	.46	60	59.7	62.3	7301	100.0	10.00
20	47.4	49.4	7822	7.0	.70	70	59.7	62.3	7301	100.0	10.00
30	47.6	49.7	7809	9.3	.93	80	59.7	62.3	7301	100.0	10.00
40	47.8	49.9	7800	10.9	1.09	90	59.8	62.4	7298	90.0	9.00
50	48.1	50.2	7788	13.0	1.30	800	59.8	62.4	7298	90.0	9.00
60	48.5	50.6	7770	16.3	1.63	10	60.0	62.6	7290	63.3	6.33
70	48.9	51.0	7753	19.3	1.93	20	60.0	62.6	7290	63.3	6.33
80	49.4	51.5	7732	23.0	2.30	30	60.1	62.7	7286	50.0	5.00
90	49.8	52.0	7711	26.8	2.68	40	60.1	62.7	7286	50.0	5.00
100	50.2	52.4	7694	29.8	2.98	50	60.2	62.8	7283	40.0	4.00
10	50.7	52.9	7674	33.4	3.34	60	60.3	62.9	7279	26.7	2.67
20	51.3	53.5	7649	37.9	3.79	70	60.3	62.9	7279	26.7	2.67
30	51.7	54.0	7628	41.6	4.16	80	60.4	63.0	7275	13.3	1.33
40	52.3	54.6	7603	46.1	4.16	90	60.4	63.0	7275	13.3	1.33
50	52.9	55.2	7579	50.4	5.04	900	60.4	63.0	7275	13.3	1.33
60	53.5	55.8	7555	54.6	5.46	10	60.5	63.1	7271	—	—
70	54.2	56.6	7523	60.4	6.04						
80	54.7	57.1	7503	63.9	6.39						
90	55.2	57.6	7483	67.5	6.75						
200	55.6	58.0	7467	70.4	7.04						
10	56.0	58.4	7451	73.2	7.32						
20	56.5	58.9	7432	76.6	7.66						
30	57.0	59.5	7408	80.9	8.09						
40	57.4	59.9	7393	83.6	8.36						
50	57.7	60.2	7381	85.7	8.57						
60	58.0	60.5	7370	87.7	8.77						
70	58.3	60.8	7358	89.8	8.98						
80	58.5	61.0	7351	91.1	9.11						
90	58.7	61.3	7339	93.2	9.32						
300	58.9	61.5	7332	94.5	9.45						
10	59.0	61.6	7328	95.2	9.52						
20	59.2	61.8	7320	96.6	9.66						
30	59.3	61.9	7316	97.3	9.73						
40	59.5	62.1	7329	98.6	9.86						
50	59.6	62.2	7305	99.3	9.93						
60	59.6	62.2	7305	99.3	9.93						

CUT: No. 1 Meter 1575120 No. 2 - 1858750 No. 3 - 1648088
RATE OF FLOW 329 B.P.H. TIME 1256 PM A.M. OR P.M. #1 Meter: #2 METER:
Raymond Parker

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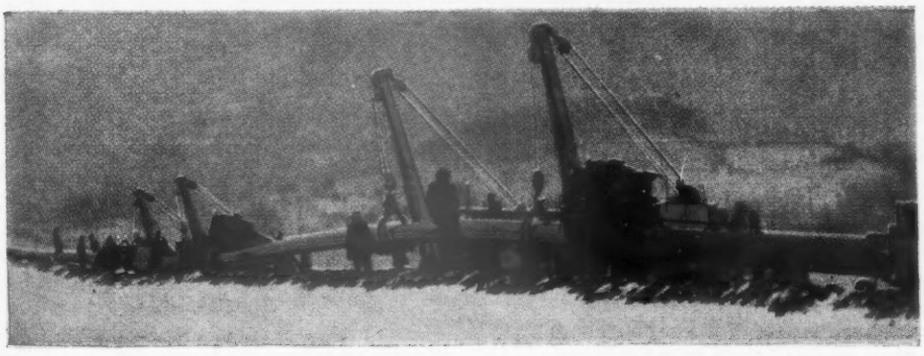

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Microwave Multichannel Radio System for Pipe Lines

WARREN T. BULLA

The Author

W. T. Bulla, superintendent of communications and dispatching for Natural Gas Pipe Line Company of Chicago. For the past five years he has been active representing American Gas Association on Mobile Radio Committee and in hearings before Federal Communications Committee.

THE user of present day communication and signal systems forgets the tremendousness of the feat in the simplicity of its accomplishment.

The use of telegraph, telephone, and teletype have been common forms of communication for many years, "AM" radio has been used by a number of pipe line companies during the last ten years, and "FM" radio has been adopted by a great many companies in years since World War II.

So, now, when we bring some thoughts on "Microwave Relay Radio," it is only another phase in the fast moving communication progress.

That portion of the radio spectrum represented by wave lengths shorter than about five meters has long been considered as the proper domain for point-to-point communication. As these ultra-short waves are not reflected by the ionosphere, their effective range is not much greater than the horizon distance and it therefore becomes possible for several stations, properly separated, to operate in the same frequency band; for the same reason, atmospheric interference is not an important factor in this wavelength range.

Recent advances of microwave technique permit the use of radio also for point-to-point communication and radio may prove to be superior to most other means. At least, we must give serious and careful consideration to this type of communication, realizing that such a system solves many of the difficult maintenance problems, as it is not subject to as many interruptions from storms, fire, etc., as is open wire on pole lines.

There are several microwave relay systems about ready for the market at this time; however, we will limit our discussion to one type of system.

Directivity

In considering the essential requirements of such a service, one is the directivity. We want to concentrate our transmitter power into a narrow beam that will be directed to a distant but known reception point. This matter of directivity is very important. A low-power transmitter can be used, making it look like a powerful transmitter from the receiving point of view; the same frequency can be used in the same location, just pointing different transmitters in different directions; and finally an excellent signal-to-noise ratio can be established where the receiver is also equipped with a high gain, highly directive antenna. Another item of particular importance is that on such point-to-point communication many channels may be provided, which is very desirable by pipe line companies.

The selection of frequencies will depend on which frequencies can best be adapted to this type of service, from those which the Federal Communications Commission may make available for the non-common carrier service. So, for our purpose we are considering the band of 6575 to 6875 mc.

Frequency Choice

Rain does not affect the lower frequencies but would probably prevent the use of frequencies higher than 9000 mc if the relay has to function without any interruptions.

The other limitation of using high frequencies is that the beam becomes too narrow and it is necessary to have very stiff antenna supports, such as buildings or large steel tanks for example, in place of flexible towers or single wooden poles that can twist and cause antenna misalignment. In general, a beam width of 3° with a tolerance on antenna twist of plus or minus 1° and a gain of the order of 3000 is probably the maximum that can be handled practically.

There are two more advantages to this frequency choice, one that there is no skip-distance propagation and thus interference is not experienced between the pipe line company operating in Minnesota and the one in the Gulf Coast area, as is sometimes experienced today.

The other is the wide band available, which permits multiplex operation. There is, however, the disadvantage that these frequencies propagate in straight lines, like light beams.

EXCLUSIVE

Thus when the distance between points of communication is large it is necessary to use repeater stations. This type of communication system we call microwave relay.

Typical System

A typical pipe line system would consist of two terminal stations and several repeaters; these repeaters may or may not be at intermediate line stations. The distance between towers is by no means limited by transmitter power, which in general is sufficient to cover several thousand miles before the received signal would disappear into the noise, but is limited by the curvature of the earth and other obstructions to line-or-sight. Over average flat terrain and with moderate tower heights of 100 ft or so this distance will average 20 to 30 miles, thus, for example, from Dallas to Houston, some eight or nine repeaters would be necessary in addition to the two terminal stations.

In this system being described, there are, we believe, some exclusive features, one of these being the use of 45° reflector. In this system the antenna is placed at the base of the tower pointing upward. At the top of the tower there is a passive 45° reflector, which is nothing more than a flat metal sheet, perforated to reduce wind resistance. There is no cable, wires, waveguide, or anything else going up the tower and once the reflector is adjusted for direction and locked in place there is no need for tower climbing (a very important item). All equipment is at or very near ground level where it is easily accessible for servicing. Another feature is the use of the same common antenna for receiving

and transmitting simultaneously. This is achieved by using cavity separation filters and different frequencies for transmitting and receiving.

In considering the equipment at the terminal station, it should be pointed out that if a roof is available at the terminal from which line-of-sight exists to the first repeater point, no tower or reflector would be used at the terminal. The parabolic antenna would be mounted on the roof so as to point directly at the repeater point.

It is anticipated that for maximum safety, independence, and flexibility, a double frequency modulation system is desirable. In this system each voice channel frequency modulates a separate small sub-carrier transmitter. The sub-carrier frequencies range from 120 kc to 1 mc. The output from all these sub-carrier transmitters is collected into one video cable, which is connected to the microwave transmitter and is used to frequency modulate it with a wide deviation of plus or minus 5 mc. At the receiving point the microwave receiver equipped with a discriminator recovers the video or sub-carrier frequencies but not the audio frequencies. This video signal can be applied to modulate the transmitter directly in the case of a repeater station, or can be applied to the sub-carrier receivers at the terminal station. These sub-carrier receivers are regular small FM receivers with limiters and discriminators capable of recovering voice frequencies. There is no apparent distortion and no cross modulation on voice frequencies, although several repeaters may be used in the system, since the voice frequencies only exist at the terminals and not at the repeaters.

This system will have the option of two types of microwave transmitters, one low-power using a klystron and delivering 0.1 watt into the antenna; the other using a 10 watt C. W. Magnetron. It is thought that no more than ten sub-carriers to modulate one microwave transmitter need be used. If necessary, more than one microwave transmitter can be used on the same antenna and tower.

Voice Channels

To give some idea of the voice channels and the flexibility in application of microwave relay, a layout has been made of a typical pipe line system. (Fig. 1).

On this sketch we have projected a long-haul pipe line of approximately 1000 miles in length with a gathering system and a number of intermediate pumping stations. Voice Channel 1 is made available primarily for dispatcher's service from the general operating headquarters to each pumping station or control point, and also serves as a local channel between all intermediate pumping stations. Voice Channel 2 provides general communication to certain district or regional field headquarters. Voice Channel 3 provides general communication between headquarters and the initial pump station and the gathering system field office. Voice Channel 4 (actually two channels) is set up for communication from the general headquarters to personnel in mobile units. It is unquestionably of great value for the dispatcher and operating departments to have direct contact with cars and trucks when planned or emergency shut-outs occur, which affect the handling of its commodity. These cars and trucks would be equipped with 2-way radio and thus could operate into the system channels as described and also from car to car.

Obviously the use of channels is completely arbitrary as all five channels can be set up as desired.

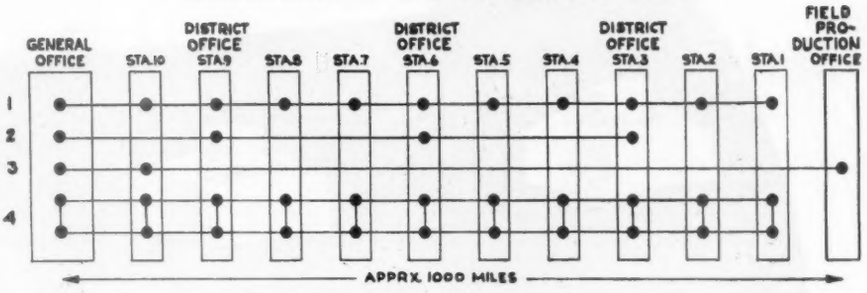
In Fig. 2 are shown typical structures for the support of the reflectors and antennas. These, as previously stated, will be approximately 100 ft in height and will be spaced at approximately 20- to 30-mile intervals. At each of these locations there must also be provided an adequate power supply and a small building to house the equipment.

This story, although incomplete, gives some idea of the applications in which a pipe line company might be interested. There are other possibilities, however, such as additional voice channels, teletype printers, telemetering and other forms of remote reading devices, facsimile, remote operation or control and selective calling.

Now the sixty-four dollar question —What-Does-It-Cost? Manufacturers are just about ready to make firm commitments and our estimate is that they will indicate a price per mile somewhat less than the present day cost of a minimum pole line carrying one copper metallic circuit.

Maintenance should be definitely less than for the average pipe line-owned communication system. ★ ★ ★

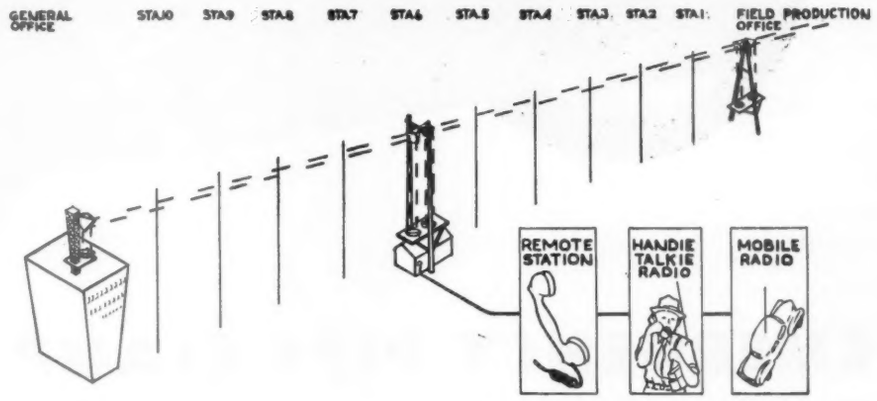
FIG. 1. Typical 4-channel (voice) microwave radio communication for long haul pipe line service.



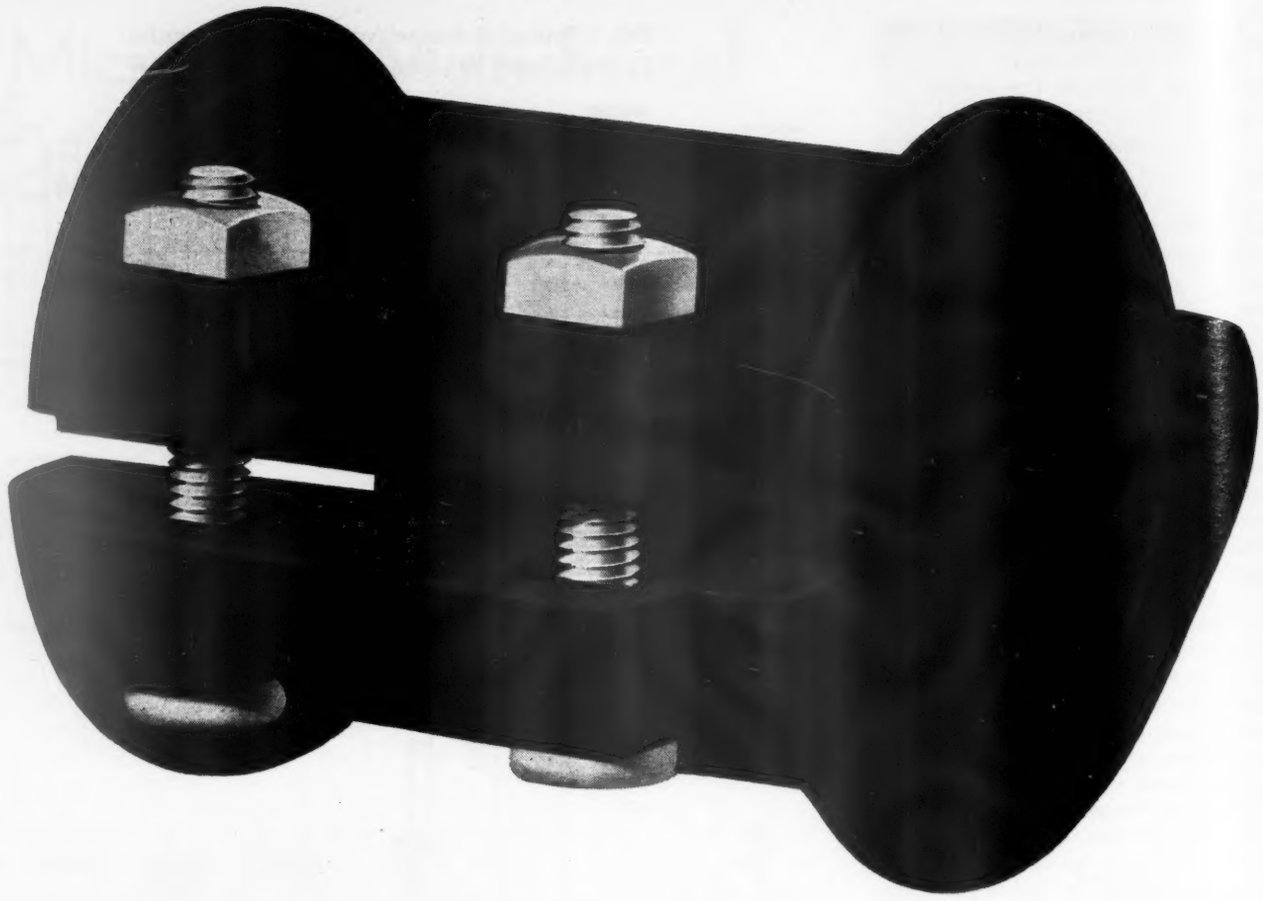
1. Primarily for dispatchers use, to coordinate pump station operation.
2. For use of operating departments, contact with field supervisors.
3. For communication to production area or gathering system.
4. For communication to mobile units.

The 4 voice channels operating on high frequencies, provide fine separate and distinct two-way talking channels comparing in quality and volume to high fidelity telephone channels.

FIG. 2



Every intermediate location or terminals, any voice channel can be available for service with the installations of proper equipment. Also referring to channels No. 4 and No. 5 as shown in Fig. 1 mobile radio units can operate 2-way any station or mobile unit.



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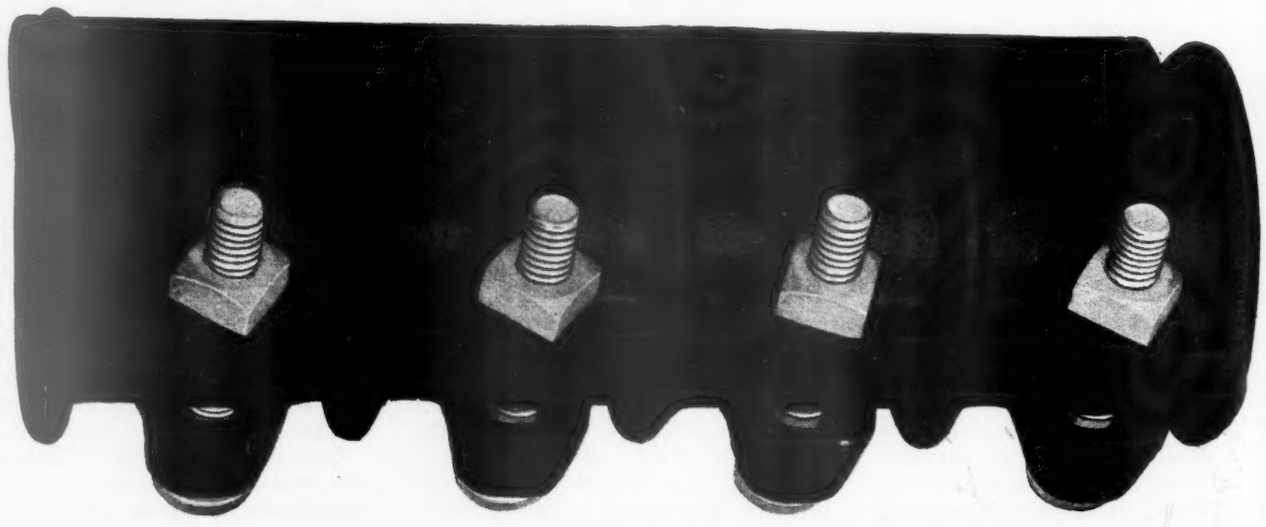


Settling Tanks Solve a Metering Problem

G. A. LUNDBERG

In the initial planning of Magnolia Pipe Line Company's 12-in products line from the Beaumont-Port Arthur area to Hearne by way of Houston, Texas, it was decided that all products delivered into and out of the system would be measured by positive displacement meters. Meters were installed at refineries at Port Arthur and Beaumont with filters on the upstream side of the meters to collect any abrasive particles that might be carried by the fluid. These filters were of the conventional felt-covered basket design with a guaranteed capacity above the maximum meter capacity.

Soon after the lines had been cleaned the meters were put into service at about 85 per cent of maximum capacity with the basket of the filter double wrapped with 1/8-in. felt. After 25 minutes of operation the pressure drop across the felt rose to about 90 psi, requiring a shut down and cleaning of felts. This same difficulty was experienced at the other refinery at even lower meter capacities.

Investigations were immediately instigated to find a solution to the problem. First, samples of the material collected on the felts were accumulated from each refinery and screened to determine the size and consistency of the material. At the first refinery the sample screened as follows:

Appearance: Brown, black mixture, very little scale.

Mesh of screen	Per Cent by weight	Appearance
20	1.24	Large flaky mill scale
40	8.48	Iron oxide spheres
60	25.11	Iron oxide spheres
80	17.82	Iron oxide spheres
100	12.56	Iron oxide spheres
Pan	34.79	Iron oxide spheres

At the other refinery the sample screened as follows:

Appearance: Grayish black color, some mill scale.

Mesh of screen	Per Cent by weight	Appearance
20	1.58	Large flaky mill scale
40	8.12	Mixture scale and rust
60	32.02	Mixture scale and rust
80	26.49	Iron oxide
100	11.05	Iron oxide
Pan	20.74	Iron oxide

Settling out tests were also run on the material retained on each screen to determine the time necessary for these particles to settle in stagnant gasoline and kerosine. These tests indicated that the settling rate was not only dependent on the size of the particle, but also on the concentration of particles. It was discovered that most of the particles settled quite rapidly in all cases and that the higher the concentration of particles the longer it took for the product to clear.

Additional meter runs were made at the refineries to determine whether the clogging rate was increasing or decreasing from the initial runs. No noticeable change was indicated, but it was noticed in one run that free moisture in the product affected the pressure drop across the felt by causing sudden pressure rises.

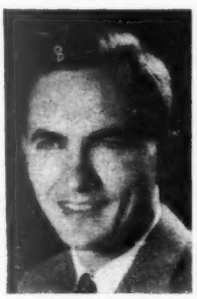
With the above-mentioned facts available, means for removing this foreign material were considered. Hay tanks, rock salt settlers, and velocity breakdown tanks were all considered. Rock salt settlers were given the least consideration even though it is a known fact they will remove all free moisture in the product, but sufficient knowledge of their ability to remove fine particles of rust and mill scale was not obtainable. Hay tanks were then considered and it was felt that this would be better than a velocity breakdown tank. After further consideration it was decided that hay tanks would be too expensive to operate and maintain so velocity breakdown tanks were designed.

The velocity breakdown or settling tanks were designed from the following data: A maximum future pumping rate from each refinery of 1800 bbl per hr with a settling time of 40 sec and a velocity in the tank of less than 0.25 ft per sec. These requirements were met by using a tank 48 in. in diam and 10 ft long with the stream entering both ends at the top and leaving in the center at the top as shown in Fig. 1. Inside on each end are baffles to prevent turbulence created by the entrances from being carried throughout the whole volume of the vessel. On the bottom of the vessel are seven compartments where foreign matter can settle and not be disturbed by the flow through the vessel. In the center on the bottom a larger settling chamber was installed so that provision could be made to install an automatic water dump trap if the operating conditions justified its installation at a later date. The blowdown from each tank is discharged into a sump where any petroleum product might be reclaimed.

During the time the meters were being put into service throughout the whole system considerable trouble was had with felts in the filters. They were practically impossible to wash clean as the iron oxide so impregnated them that it would not come out regardless of the method employed. As it would be too expensive to purchase new felts to replace the dirty ones, for they were changed very often at the beginning, 100-mesh screens were substituted for the felts and such good results experienced that they are now used throughout the system. It was discovered while trying the screens that by backwashing the filter element while in the filter housing it was possible to wash the screens clean of any accumulation, thus restoring the elements to their normal operating condition.

After the settling tanks were in-

THE AUTHOR



G. A. Lundberg joined the staff of Magnolia Pipe Line Company in 1939 immediately upon being graduated from Texas A. & M. College, where he received the degree of mechanical engineer. He spent six months in the field and was then transferred to the main office in Dallas, Texas. His position was that of draftsman. He is now assistant mechanical engineer. His technical society affiliation is with the American Society of Mechanical Engineers.

EXCLUSIVE

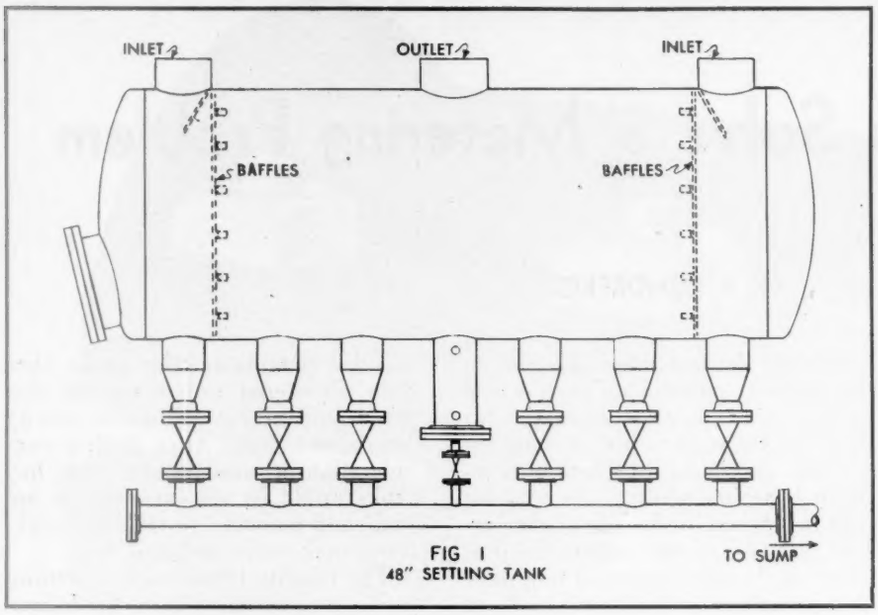


FIG 1
48" SETTLING TANK

stalled at each refinery, the meters and their filters were put into service, and since that time it has not been necessary to clean the screens; however, filter elements have been removed periodically for inspection to be sure that the meters are protected properly. It has been noticed that extremely fine iron oxide tends to cake on the upper part of the filter elements, but this was eliminated by periodic blowdowns. These extremely fine particles do not cause much concern as they do not hamper operations or cause appreciable wear on the meters.

In operations, the settling tanks are blown down by gravity before each batch delivery is started. When the tanks are blown down there is always evidence of water and iron oxide, which indicates the trouble is still there and that the settling tank is functioning properly.

From a study of the data on batch changes, there appears to be no appreciable increase in commingling between different gasolines since the installation of the settling tanks. When kerosine is pumped the tank is drained to hold the commingling to a minimum.

Fig. 2 shows another settling tank that was designed for the following conditions, 1000 bbl per hr, 0.25 ft per sec velocity in the tank, and a 40-sec settling period. This tank, which is at the sales terminal in Houston, has not been in service as long as the other two settling tanks, but present information indicates it will function as well as the two at the refineries.

* * *

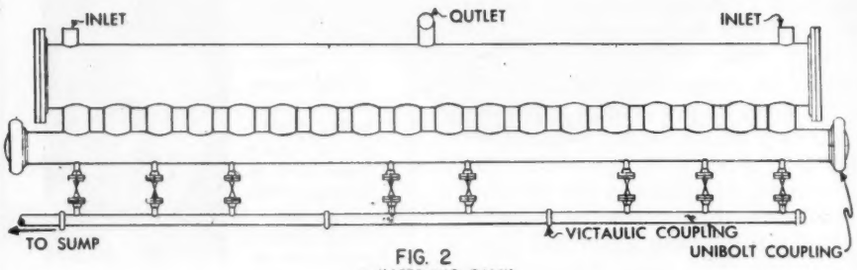


FIG. 2
24" SETTLING TANK

P 615.512.

IMPORTANT FACTORS IN DIESEL ENGINE OPERATION

On the whole the two details that are most important in the operation of a diesel engine are: (1) Lubrication, and (2) cooling water.

Although lubrication is the more important of the two, they are interrelated. Thus, for instance, the writer has in mind a diesel engine of well known make that was allowed to operate for too long a period with cooling water temperature in the vicinity of 200 F. If the cooling water had been distilled, or even conditioned, it would not have been so serious, but this water wasn't treated in any way.

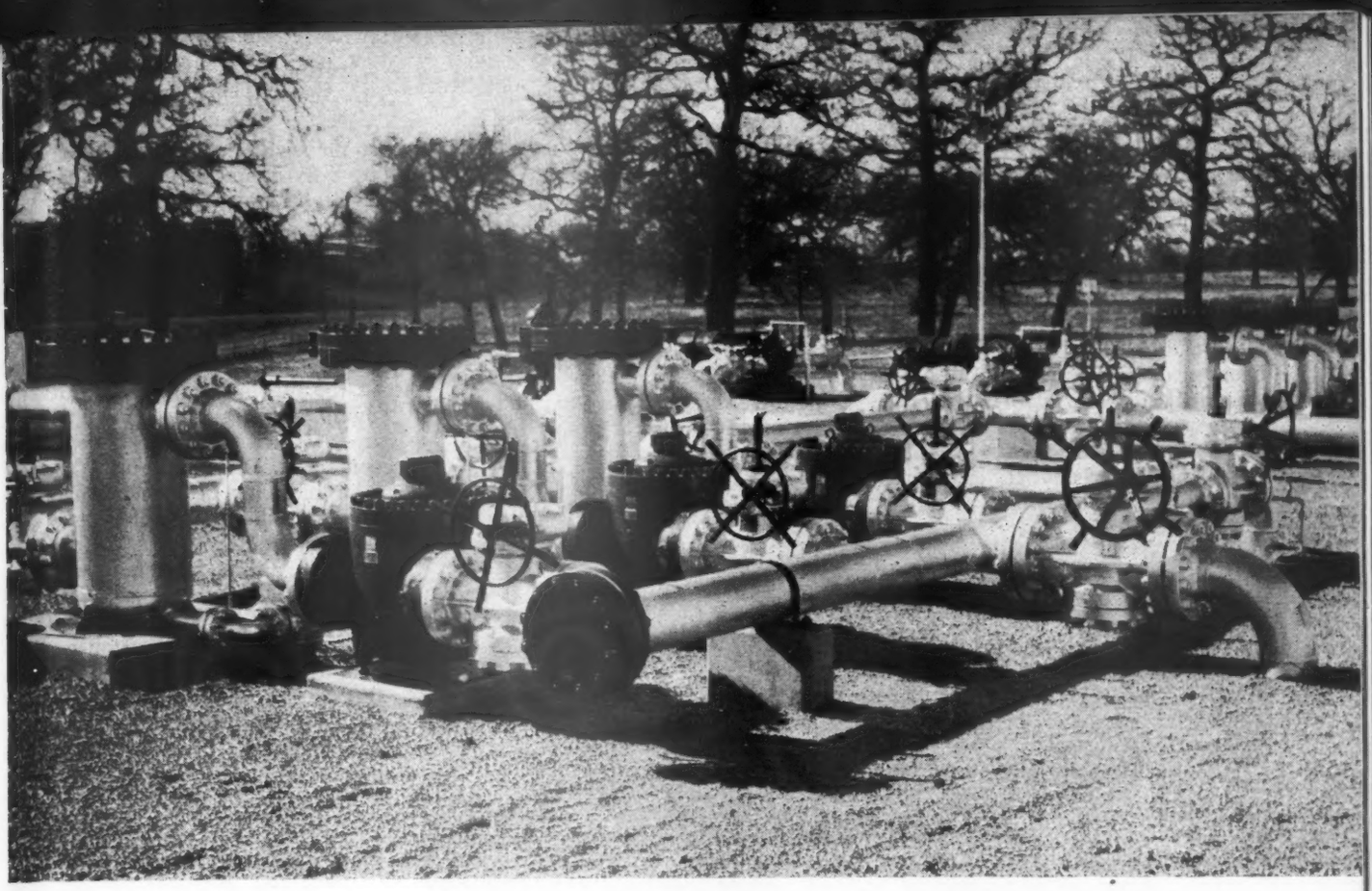
Scale accumulations built up in the cooling jacket, of course, and clogged the passages. That led to high cylinder wall temperatures and the lubricating oil could not function properly. That is where cooling water and lubrication are interrelated. The pistons stuck, scored the walls, and wore excessively.

Finally an "expert" was called, and it didn't take him long to put his finger on the cause of the trouble—the impure cooling water.

Going back to lubrication, have you ever noticed on reading through your diesel operating manual that lubrication is mentioned oftener than anything else? That, in a way, emphasizes its importance. Lubrication is what keeps the engine from wearing out quickly. All other conditions being right lubrication is what permits the diesel to operate at its remarkably high efficiency year after year.

There is such a thing, too, as giving a diesel "too much" lubricant, believe it or not. It is well to be careful about that point although too much lubricant is better than too little. By giving the engine too much oil carbon deposits will form. If such deposits persist in forming, don't blame the lubricating oil, blame yourself. The best way to oil a diesel engine is to use a force feed lubricator, feeding the oil directly onto the piston between the piston rings. Attach the lubricator to the engine and mechanize it in such a way that the amount of oil fed is in direct proportion to the number of strokes. Feed the oil against the piston while it is at the end of its stroke so that the oil will "catch" and so that it will not blow out or be sucked out.

The color of lubricating oil has nothing to do with its ability to lubricate. Therefore, don't be enticed into buying a "good-looking" oil simply for its looks. The lubrication problem is well worth studying carefully. Study both the lubricant and your engine and when the lubrication problem is once solved you will be pleased because of the small amount of attention the engine will demand of you. To flood an engine cylinder with oil may eliminate much of the friction, but on the other hand it may cause serious and costly trouble.—W. F. S.



A group of meters for measuring flow. Measurement is made both on the incoming and outgoing streams.

Adaptability Highlights Station Design

FRANK H. LOVE*

WITHIN recent months Sinclair Refining Company, Pipe Line Department, has extended its products system from Chicago to Houston, Texas, and added 15 pumping stations and 10 distribution terminals. This gives the company a continuous line from the Gulf Coast to the Eastern Seaboard with several branches to important consuming centers. Construction of the system as a whole began as far back as 1941 when a line was laid from the Marcus Hook, Pennsylvania, refinery to Steubenville, Ohio, with branches to Baltimore and Washington. In 1943 a line was laid from Chicago to Toledo; in 1945 from Toledo to Detroit and from Toledo to Columbus, with a line tying in at Marion that extends to Steubenville by way of Akron and Youngstown. From Akron a spur goes to Cleveland.

The work completed late in 1948 included the laying of a new 10-in. line from Houston to Arlington, Texas, and a new 8-in. from that point to Shawnee, Oklahoma. At Shawnee a tie-in was made with an 8-in. line that previously had been used for crude oil. This line extends to Chicago and was reconditioned before being utilized for the transportation of products. Another 8-in. crude oil carrier branches from this line at Standish, Missouri, and extends to St. Louis and Wood River, which, of course, also was reconditioned.

On the new system, pumping stations were constructed at Houston, Hearne, and Arlington in Texas; Thackerville, Stratford, Drumright, and Copan in Oklahoma; Iola and Kenneth in Kansas; Carrollton, Mexico, and Gibbs in Missouri, and Lomax, Monica, and Mazon in Illinois. Terminals are at Ardmore, Shawnee, Iola, Carrollton, Mexico, Fort Madison, Galesburg, Streator, Joliet, and Wood River. A terminal is now under construction at St. Louis, Missouri.

EXCLUSIVE

Features of System

The outstanding features of the system as a whole are its flexibility and standardization of design. Pumping can be in either direction, and by a system of working storage points it is possible on short notice to provide a consuming area with a change in product when the occasion demands. Standardization in design and equipment results in smaller warehouse stocks because of the interchangeability of equipment between stations. Standardization also helps to solve a personnel problem inasmuch as operators can be transferred from

*Pipe Line and Marine Transportation Editor.

one station to another and be entirely familiar with equipment and operations.

Station Description

As design is standardized, one station, Arlington, Texas, has been selected for description in this article as typical of all. It perhaps should be mentioned, however, that, although standardized, there is variation in the number of pumping units at some of the stations. The Arlington station is one of the larger installations and also has working storage, which all do not.

When products arrive at Arlington from the originating point at Houston, the stream can be sent to storage, pumped straight through to Thackerville, the next station on the line, or, if expedient, the station can be bypassed.

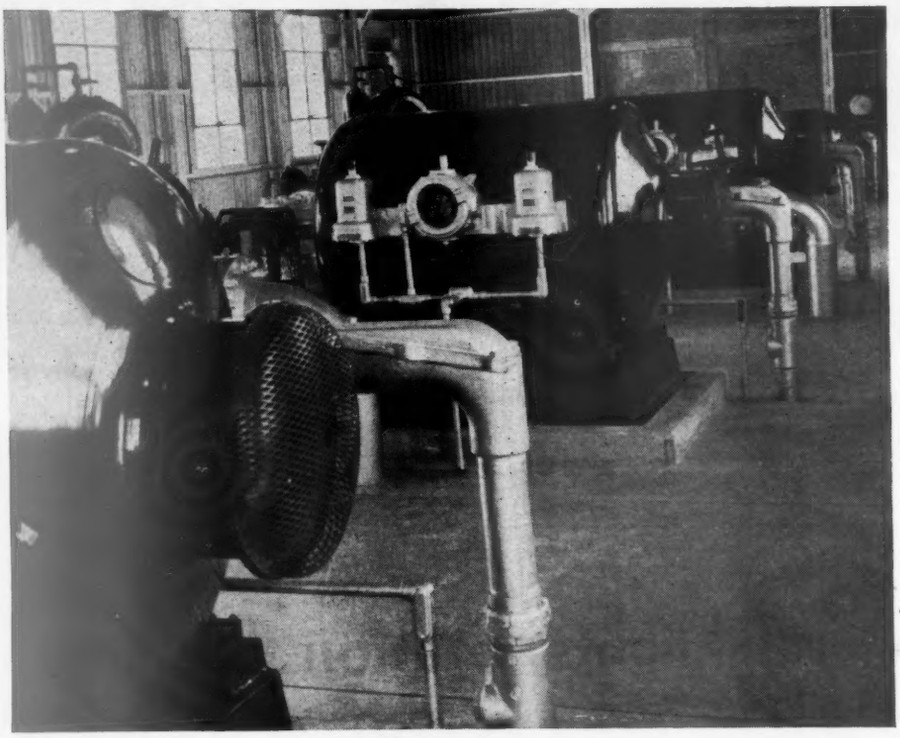
The main line pumping units are three in number and consist of 6 by 6, 4-stage pumps driven by 400-hp, 3-phase, 60-cycle, 2300-volt, 87.3-amp motors. The pumps have a rated capacity of 1100 gpm at a speed of 3550 rpm. These main line pumps can be operated individually or in series.

Products are boosted from storage to the suction of the main line pumps by 5 by 5, single-stage pumps driven by 40-hp motors.

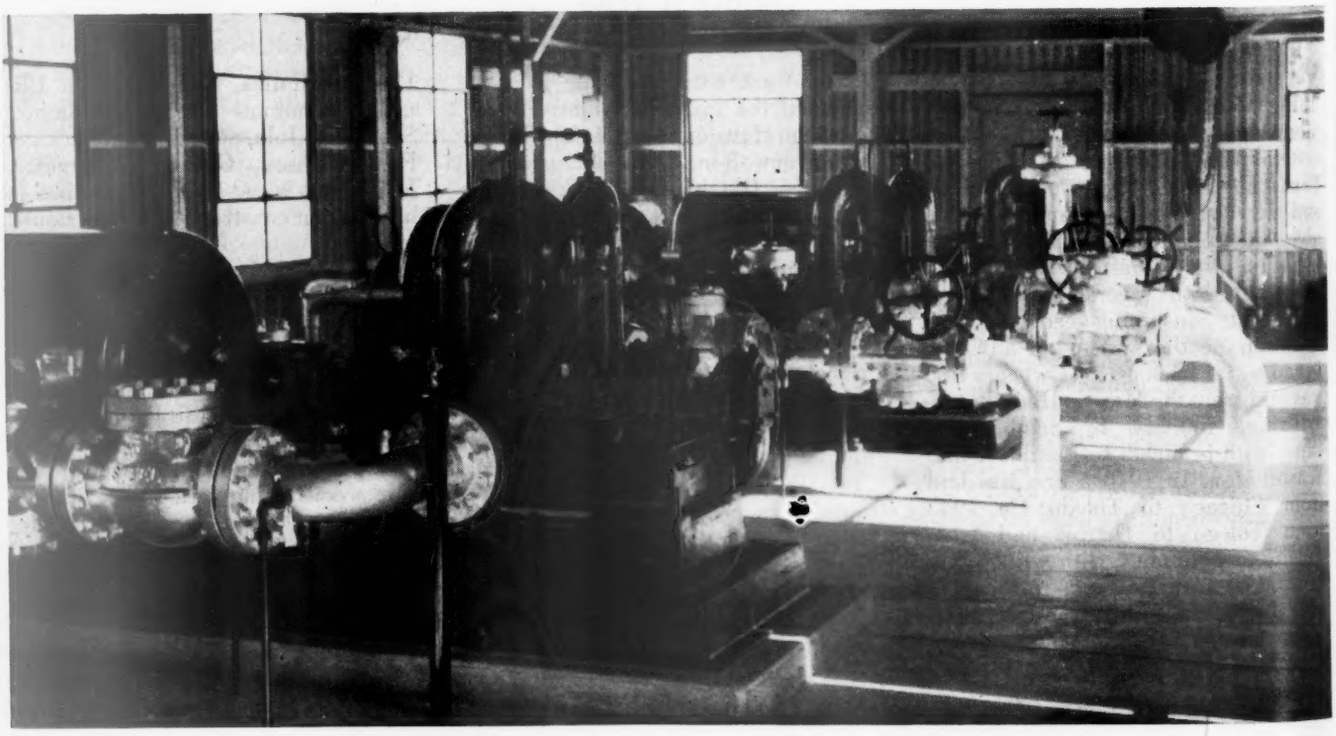
Flow is recorded by two types of meters, a counter type and an electrical chart recording meter. Measurement is made both on the incoming and outgoing streams.

Arlington station differs from some of the others because in addition to pumping straight through on the main line, branch lines go to distribution centers at Dallas and Fort Worth and equipment has been installed for this purpose. The lines to these two cities are 3-in. and there is a pumping unit for each, although the units are so arranged that the stream can be split and a single pump used to pump to Dallas and Fort Worth simultaneously. Products flow by gravity from storage to the suction of the pumps, which are 8-stage units having a rated capacity of 350 gpm at 3580 rpm with a 1990-ft head. The driving power is a 200-hp, totally enclosed, fan-cooled motor for each pump. The motors are 2200-volt, 60-cycle, 44.4-amp units.

Discharge pressure on the main line from Arlington is 800 psi and the discharge pressure to Dallas and Fort Worth is 1100 psi. Line pressure is controlled by an air-actuated control-



Main line pumps are driven by 400-hp, 3-phase, 60-cycle, 2300-volt, 87.3-amp motors.



Main line pumps at Arlington consist of three 6 by 6, 4-stage centrifugal units. They have a rated capacity of 1100 gpm at speed of 3550 rpm.

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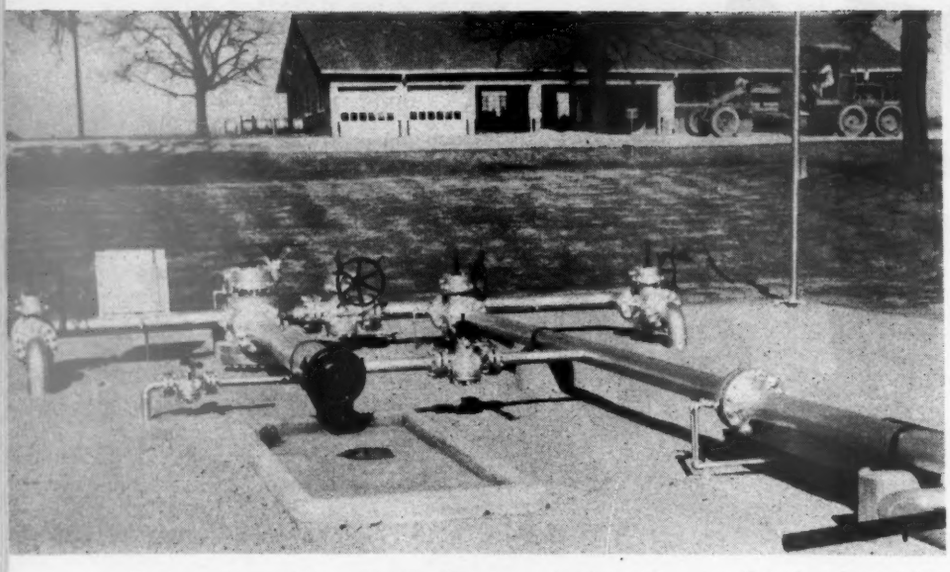


Each station is equipped with a scraper trap for insertion and removal of "pigs" used to clean the lines internally.

ler. Each pump on the main line has a rated capacity of 850 bbl per hr.

Controls

The control building, which is of brick construction, is separate and situated some distance from the pumphouse, which provides a safety feature as well as greater quietness for the operating personnel. It should be mentioned, however, that station equipment can be operated either from this control building or from the pumphouse. Two instrument boards in the control building place the operation of the station at the finger tips of the men on duty. One panel is for the various pressure recording instruments, the other for electrical equipment. The latter contains the mercoid switches, start and stop stations, and indicating trouble lights. In event of such difficulties as hot bearings, excessive line pressure, low air pressure, etc., indicating lights come on and a warning horn blows, or the station is shut down, depending on the severity of the trouble. These are factors in safe operation of the station, which further include a remote substation from where the equipment can be started or stopped, the location of high-voltage electrical equipment and switchgear at an outside location in weatherproof housing but remote from the control and pump buildings, as well as ample fire-fighting equipment strategically placed throughout the plant site.

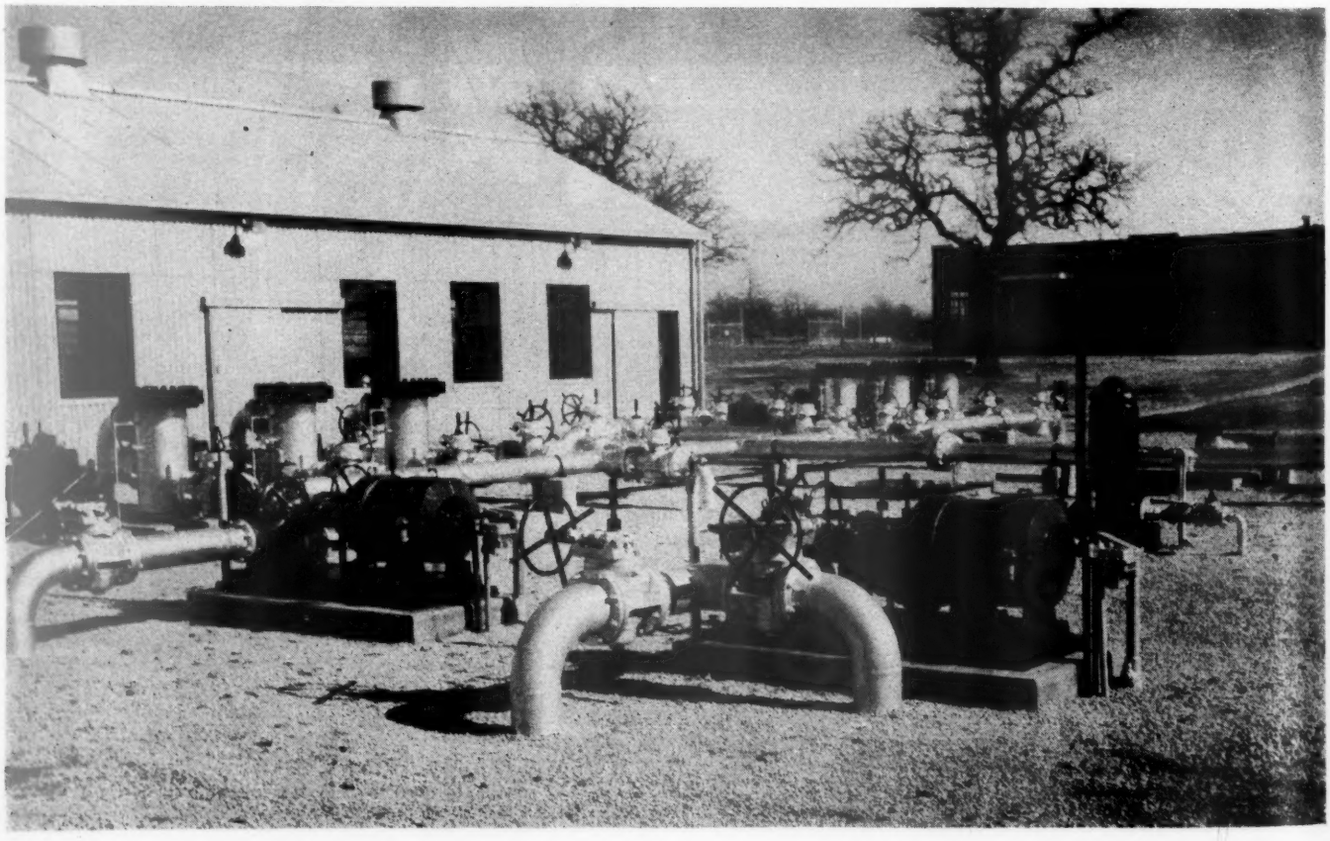
Communications

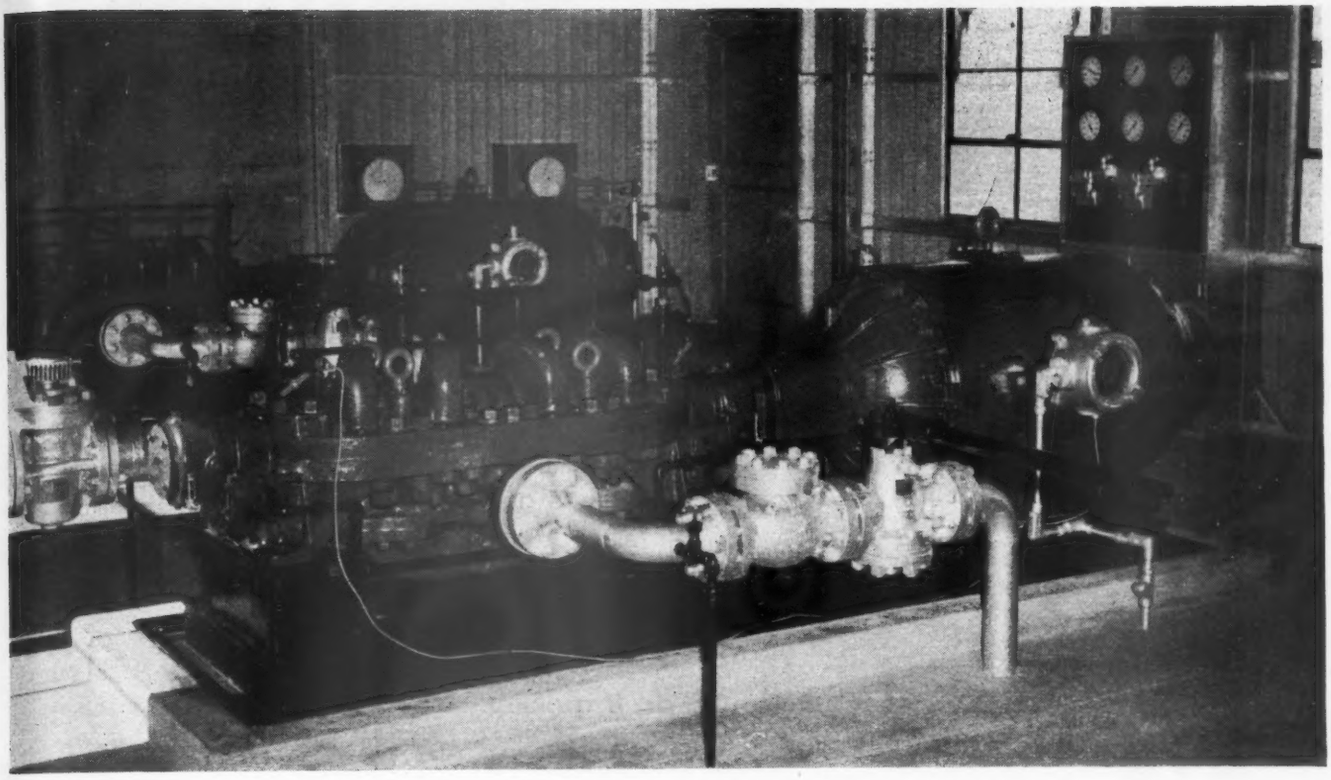
The nature of pipe line operations, with hourly reports, emergency calls, dispatching, the numerous calls attendant to routine operation and maintenance, makes it essential that a reliable communications system be provided. To assure that communications will never break down Sinclair has available not one but several means of contact with headquarters at Independence, Kansas, and with other stations and terminals along the line. It has its own multiple-channel carrier equipment, it has leased wires and a teleprinter, and in the remote possibility that all these means should fail at the same time, the commercial Bell telephone system is available.

Dispatching

Eight different products are being batched through the line, which makes the importance of proper dispatching obvious. Gravitometers installed on

Products are boosted from storage to suction of main line pumps by these 5 by 5 single-stage pumps driven by 40-hp motors.





Products are pumped from Arlington to Dallas and Fort Worth through branch lines. Pumps are 8-stage units driven by 200-hp motors. Gravitometers are in background.

the incoming and outgoing main lines weigh and record the gravity of the product, and hydrometers serve as an additional check to show a change in the product being shipped. As a further aid, a dye slug is injected between each batch as a warning of change in product.

Tankage at Arlington station consists of five 80,000-bbl vessels. A sixth tank of the same capacity is now being erected. Three have floating roofs and three cone roofs. The tanks are gauged by means of automatic tank gauges that show the fluid in each tank to one-eighth of an inch. Readings are taken from a panel situated in the control building.

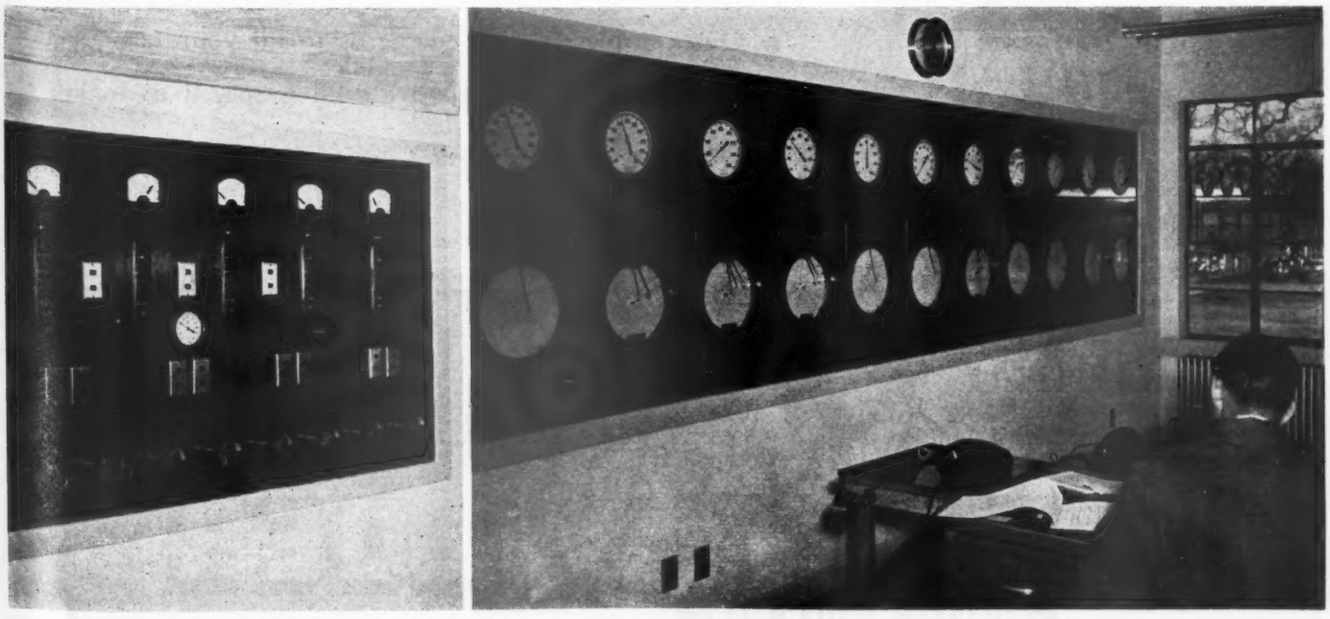
The pumphouse is of steel frame construction with transite covering. The control building and the district office and warehouse building are of brick and plaster construction. The control building contains showers and lockers for the operating crew. All buildings are heated by hot water systems.

Stations on the system are completely electrified, power being purchased from utility companies.

The Foor Engineering Company of Oklahoma City, Oklahoma, was the contractor in charge of station construction.

* * *

Shown here are two instrument boards in the control building which place the operation of the station at the finger tips of the men on duty.



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Blasting loose a pipe line channel in heavy shale on bluff overhanging White River crossing of the Rangely-Salt Lake pipe line. In background line's right-of-way can be seen stretching into the Rangely oil fields.

Line Feeds Rangely Oil to Utah Plant

RICHARD SNEDDON*

Of undoubted importance to the Rocky Mountain states, and, indeed, to the entire northwestern area, including Oregon, Washington, and western Canada, are the recently completed facilities of Salt Lake Refining Company, and the Salt Lake Pipe Line Company's line to the refinery from the Rangely field in Colorado.

*Pacific Coast Editor.

These two companies are subsidiaries of Standard Oil Company of California, and their development program is the integrated answer to a problem in economics that should prove of distinct advantage to the areas involved. For one thing they provide a much more assuring picture of future oil supply and coincidentally ease the load on California production.

EXCLUSIVE

The 182-mile 10-in. pipe line extending from the Rangely field to Salt Lake City was begun in May, 1948, and was completed in November of the same year after a dramatic race with the elements. It was feared that the coming of the snows and freeezing weather might halt proceedings before

the work could be finished, but fate was kind and the project was completed on schedule.

The contract for the laying of the line, amounting to some $5,000,000, was awarded to Pacific Pipeline and Engineers Ltd., and actual purchase of the pipe was made by Salt Lake Pipe Line Company.

About 85 per cent of the supplies were handled at two Utah points—Charleston and Park City, with the remainder being unloaded at Craig, Colorado.

Coincidentally with the laying of the line the refinery was being constructed and the two operations were so correlated that the line would be completed and ready to carry oil to the refinery by the time the latter was ready to go on stream.

Through Rugged Country

The laying of the line was a pretty rugged operation, traversing a great diversity of terrain and requiring the utmost of engineering skill to overcome the many difficulties that lay in the way. The route wended high into Utah's mountain passes, through fertile valleys, and across many miles of barren desert land where sand offered its usual concomitant of trouble.

The highest elevation reached was on the heavily wooded slopes of the Uinta National Forest about midway along its route. Here operations were carried on at a height of 9560 ft in Wolf Creek Pass. This, incidentally, is believed to be the highest point in the United States traversed by a maior pipe line. The going was tough at this point. On a right-of-way hewed out of the timber, heavy tractors had to be used to move welding equipment and other supplies up the steep inclines on sleds improvised from pieces of pipe. The way was so rough that no wheeled vehicle could negotiate it and dogged persistence teamed with the acumen of experience to carry the line over this stretch.

In the bare eroded hills at the eastern end of the line, even the automatic ditch diggers couldn't always cut their way through the earth. Not infrequently the job had to be entrusted to the powder men who had to blast a way through rock-like surface shales with dynamite. The crews were not to be refused, however, and satisfactory progress was made despite the most formidable obstacle. Welders, engineers, cat skinners, and pipe line coaters and wrappers moved steadily along, each doing his important bit to beat the advent of winter and complete this conduit through which 20,000 bbl of oil daily would soon be carried over the mountains to Salt Lake City. It has been estimated that the welders used more than 25,000 lb of welding rod in the notched joints of the line, the initial pass ordinarily being a stringer bead from a $\frac{3}{16}$-in. rod, followed on most of the line by two other passes from a $\frac{1}{4}$-in. rod.

With the refinery scheduled to go on stream in November, 1948, (it actually started in December), storage of approximately 180,000 bbl was erected at the pipe line terminus. It took some 15,000 tons of pipe for the line, which was protected along its entire length against corrosion. Part of it was coated with Somastic at a plant near Heber, Utah, and part wrapped with a coating of primer, asphalt, fiber glass, and asbestos felt. The Somastic coated pipe was laid in all areas where the soil was deemed to be severely corrosive.

As welds were completed, and before lowering the strings of pipe into the ground, X-ray examination of sample welds was made on each day's work. The welders were subject to constant check, and were shown the X-ray negatives of any faults that might necessitate the rewelding of a joint. Thus the crew was developed to a high sense of efficiency, and the entire project was invested with a high degree of safety.

Pump Stations

The construction of the line also involved installation of two pump stations, one at the eastern end of the line in Rangely, and the other at Hanna, in Utah's Duchesne Valley. The latter station moves the oil over the summit at Wolf Creek Pass, the high point already mentioned. Thence it flows by gravity to the 600-acre refinery site near Salt Lake City.

These two stations determine the initial capacity of the line—approximately 22,000 bbl a day, which could be increased to as high as 40,000 bbl a day by the strategic installation of a third station. The Rangely station

X-Ray examination of welds on Rangely-Salt Lake pipe line.

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The Walworth 26-inch Series 600 Cast Steel Gate Valve shown here is for pipe line service. It is a motor operated, double disc, parallel seat type of gate valve with hard faced seats and discs; flanges faced and drilled. The valve is designed for 1200 psi working pressure — and meets all the requirements of API Standard 6-D for Pipe Line Valves.

In addition to motor operated valves, pipe line gate valves are available for handwheel operation, either direct or through single or double enclosed beveled gears.

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pumps crude oil into the line under a pressure of 1450 psi to Hanna, where the second station boosts it over the mountain pass.

The Rangely Field

Standard of California's development of both transportation and refining capacity in the so-called Intermountain area, had its beginning in 1931 when The California Company began drilling operations in western Colorado. One year later this company had brought in its first well in the Rangely field, a well tapping the Weber sand at 6228 ft and yielding refinable crude of about 35-deg API gravity. For some years thereafter The California Company was too fully occupied with other more urgent operations to devote much time to the Rangely play, and activities there were temporarily discontinued. During the war years, however, Rangely came back into the oil producing picture when the consumption of crude rose to prodigious dimensions. In July, 1944, The California Company brought in another good well in the field and Rangely quickly became recognized as a potential supply source of consequence. Development has continued through the postwar years, largely due to the rather amazing fact that the high war demand for petroleum and petroleum products has been maintained almost unabated into the peace years.

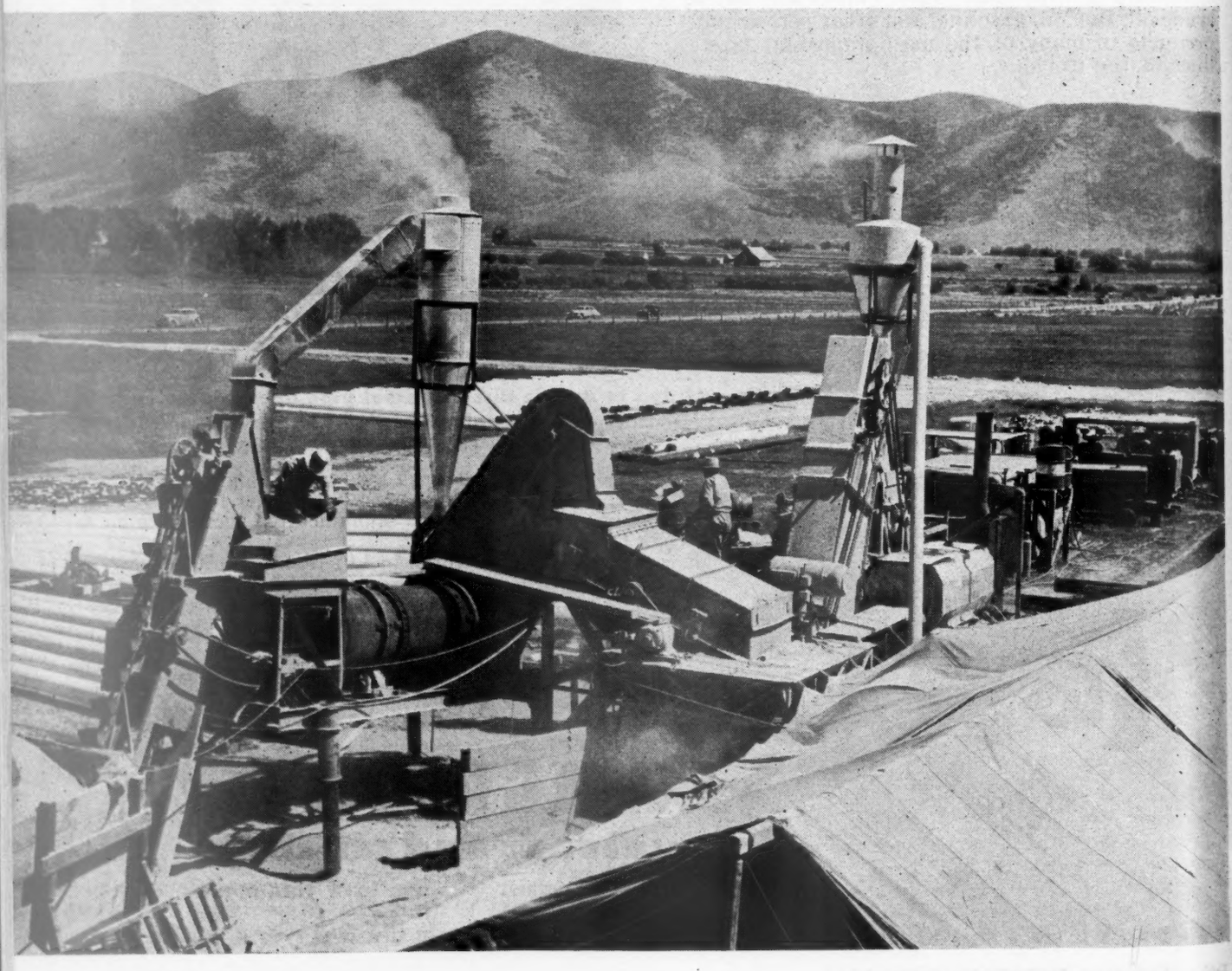
The importance of the field being conceded, attention was then focussed on the necessity for adequate transportation facilities, without which the cost of exploiting any oil property or oil field becomes prohibitive. It was partly to provide an outlet for The California Company's oil, then, that Standard of California decided on the construction of a pipe line, and refinery facilities.

Preliminary studies of the line's route were begun in February, 1947, and actual construction began about 15 months later. Three contract crews moved onto the right-of-way. One group started at Rangely and worked westward; another group set up headquarters near Wolf Creek in the Duchesne Valley and worked west to meet a third group, working eastward from a point near Heber.

Salt Lake Refinery

Meantime work was progressing on the construction of the Salt Lake refinery, another $5,000,000 job. With a rated capacity of 25,000 bbl a day, the refinery consists of a crude distillation unit with atmospheric and vacuum towers, furnaces, power plant, stabilizing, and stripping columns, and a total storage capacity of more than 800,000 bbl. Loading racks, an important item in the set-up are capable of loading 40 railway tank cars simultaneously.

Somastic plant at Charleston, Utah, in which the pipe for the Rangely, Colorado, to Salt Lake City, Utah, line was treated.



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Knocking clamp off a pipe line joint, which was just coated with somastic.

All portions of the refinery have not been completed as this is written, but oil is coming in over the line from Rangely at the rate of 15,000 bbl a day. The plant employs 80 to 90 persons; the pipe line about 45; and together they will have an annual payroll of $500,000.

The facilities are regarded by Standard of California as the initial step in a long range program to serve the Intermountain region. Further expansion depends, of course, on the development of convenient oil sources, and the growth in demand in the marketing area. At present the pipe line primarily carries the oil from The California Company's 200 producing wells in the Rangely field, and from the same company's share of a joint producing operation in the Wilson Creek field in Colorado. Recent discoveries in eastern Utah may become a factor in future expansion of operations, but that has yet to be determined.

Contributes to Growth

The entire venture should play a signal part in the industrial growth of the Intermountain states. It is the beginning of a species of enterprise that may blossom into much larger dimensions as have similar efforts in the past. At the very least it provides the means and modus for capitalizing on natural resources, which without the transportation and refining facilities would be of little value to the area. As it is, it is likely not only to grow substantially of itself, but to stimulate the competitive urge in others—to bring in related businesses and enterprise. It has already added decidedly to work opportunities for the people of the territories involved, and offers a supply of security to the whole northwestern area that is much to be desired.

* * *

Welding the 31-in. pipe near Guadalupe Mountains, Texas.

El Paso's Texas-California Line— Second Stage of Construction

C. L. PERKINS*

EL PASO NATURAL GAS COMPANY'S much publicized California line was completed in its first stage, namely, delivery of 175,000,000 cu ft daily to California, in January, 1948. The second stage of construction of the California line included increasing deliveries to Southern California, West Texas, Arizona, and New Mexico. This expansion of El Paso's facilities will be completed before this article is published. The facilities required for this expansion were designed, engineered, and installed by the El Paso Natural Gas Company's organization with the exception of purification-dehydration plants, which were processed by The Fluor Corporation, Ltd., and The Stearns-Roger Manufacturing Company.

J. E. Eichelmann, chief engineer for El Paso, supervised the designing, engineering, and drafting departments. Surveying parties were supervised by J. F. Schaffer. Inspection was done by Stone and Webster Engineering Corporation, with H. F. Anthony in charge. C. C. Selly supervised the plant building construction department and R. W. Harris was in charge of the pipe line construction department.

*Vice president and general superintendent, El Paso Natural Gas Company.

EXCLUSIVE

Pipe Line Construction

The El Paso Natural Gas Company's pipe line construction crews laid more than 600 miles of pipe lines during 1948, ranging in size from 4-in. OD to 31-in. OD, a schedule of which is shown herewith. The routes of these lines traversed various types

of terrain—the cultivated lands and plains of the Texas Panhandle, the rolling hills and mountains of West Texas, the irrigated valleys and deserts and mountains of southern New Mexico and southern Arizona. A crew was working near Dumas, Texas, in the Panhandle, while at the same time another was laying a line to Yuma, Arizona, a distance of 1037 miles, representing the extremes of the El Paso Natural Gas Company's transmission system, which comprises 3712 miles as of the end of 1948.

Pipe line constructed—1948. Schedule of pipe laid.

Size, in.	Miles
31	49.1
30	66.5
26	2.0
24	203.1
18	14.4
16	25.7
12¾	17.8
10¾	12.0
8⅝	28.3
6⅝	32.3
5	78.1
4½	31.0
4	46.8
	607.1

The 24-in. line from Eunice, New Mexico, to Dumas, Texas, was what may be termed a pipeliner's delight. This line crossed the flat plains country where there were towns of adequate size and only 20 to 30 miles apart, thus enabling the crews to be housed and fed relatively close to their work. Along other sections of the line we were not so fortunate because the great distance between towns made it necessary for the crews to be hauled 50 to 75 miles daily, and much of this over graded and unimproved roads.

Together with the constant battle to obtain the necessary pipe due to shortages, unseasonal high winds were a contributing factor to lost time on the job.

The combination of dusty right-of-way and high winds made it necessary for the company, in many instances, to haul water and sprinkle the right-of-way adjacent to the firing line, and also to construct various types of wind shields and structures to protect the men engaged in the various phases of operations. Obviously, in a project of this size, means of communication were an important factor. Recognizing the need for rapid transmission of messages in expediting the work and making for more efficient operation and closer supervision, radios were installed in the cars of key members of the various construction crews. In this manner thousands of miles of travel were saved. The travel for the direct supervision was provided by two Bonanza planes, which were placed at the disposal of the supervising personnel of both the construction and operating departments.

Stringing and Ditching

Conventional methods were used in unloading line pipe from cars, and hauling and unloading by sideboom tractors on the right-of-way. Except for extremely long hauls, no unusual difficulties were encountered in this operation. Dunn Brothers of Dallas, Texas, Parkhill Truck Company of Tulsa, and company operated trucks were used in all the hauling and stringing for the project.

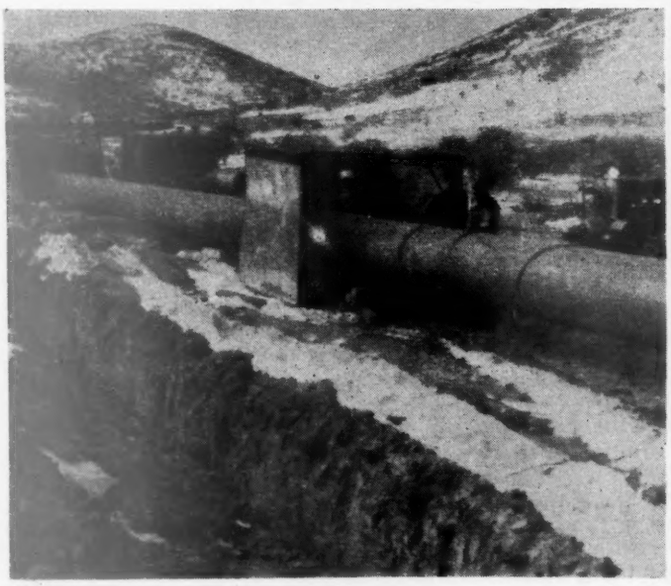
Wheel type ditching machines were used where soil formation permitted. In rocky formations and tough soils a heavy ripper was used successfully ahead of the ditching machines, also blasting was done ahead of the machines in sections of caliche and rock formation. Both of these operations expedited considerably the ditch operations and were very economical so long as discretion was used by the trenching machine operator in raising his wheel over extremely tough digging rather than grinding away, which would result in increased down time and repairs to the machine. In drilling for blasting in rock formations, an adaptation of wagon drills was used and the trench cleaned out by trench hoes. These drills were mounted on a half track along with the air compressors. This unit moved down the ditch line drilling 2¼-in. by 6-ft holes spaced at 2 to 3-ft intervals. The holes were heavily loaded with bag powder. It was found that combination of the heavy loading and the drilling of holes 12 in. deeper than grade eliminated to a great extent the necessity for reshooting the ditch.

Slopers were installed on trenching machines in areas of caving and sandy soil and drags were used to level the bottom of all machine ditch. In sections where the ditch was dug in rock, the bottom was padded with soil and the pipe was also covered with soil prior to backfilling.

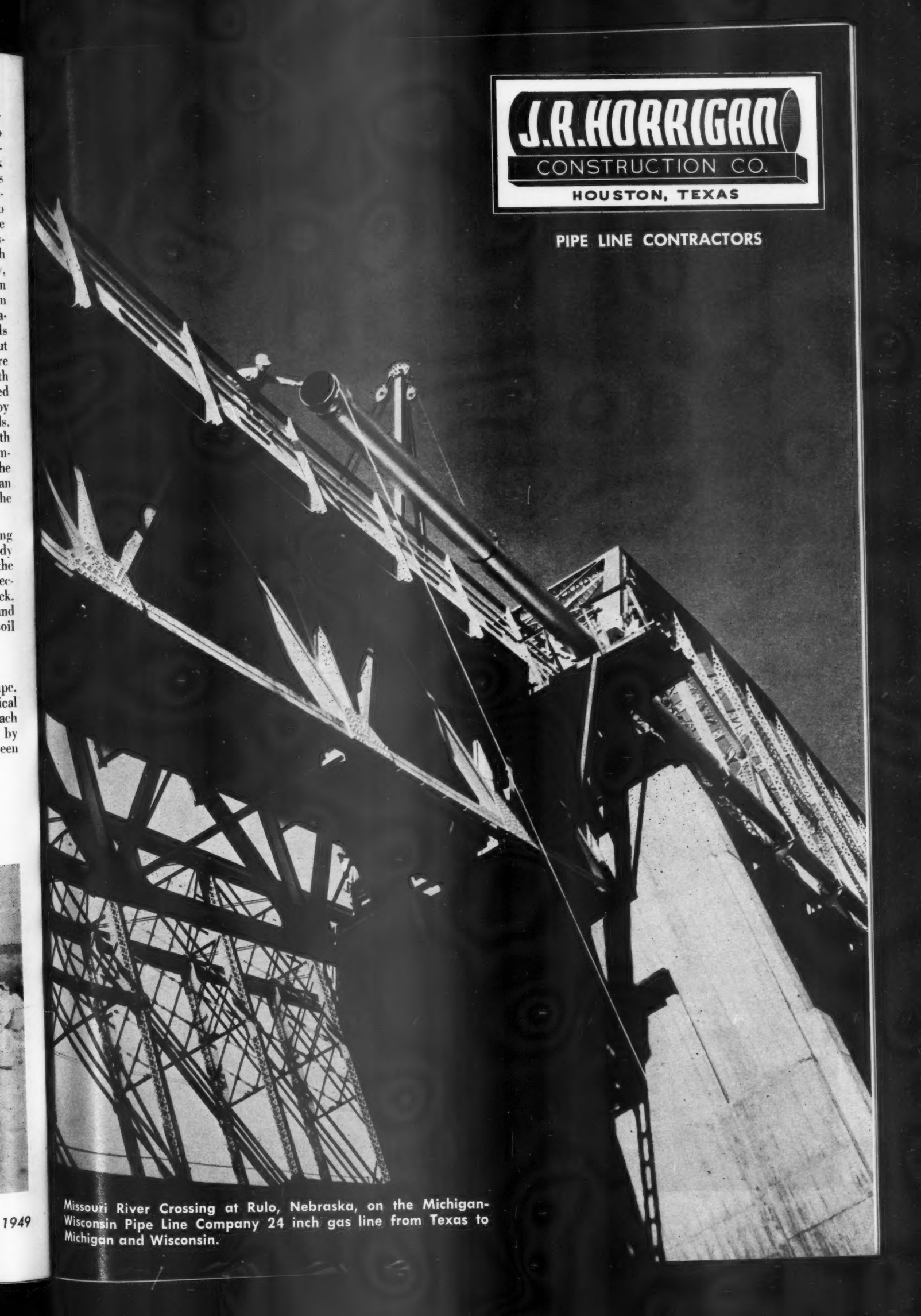
Line Up and Welding

In lining up large diameter pipe, internal line-up clamps of mechanical type were used. In lining up, each bevel of the joint was cleaned by grinding, or if the bevels had been

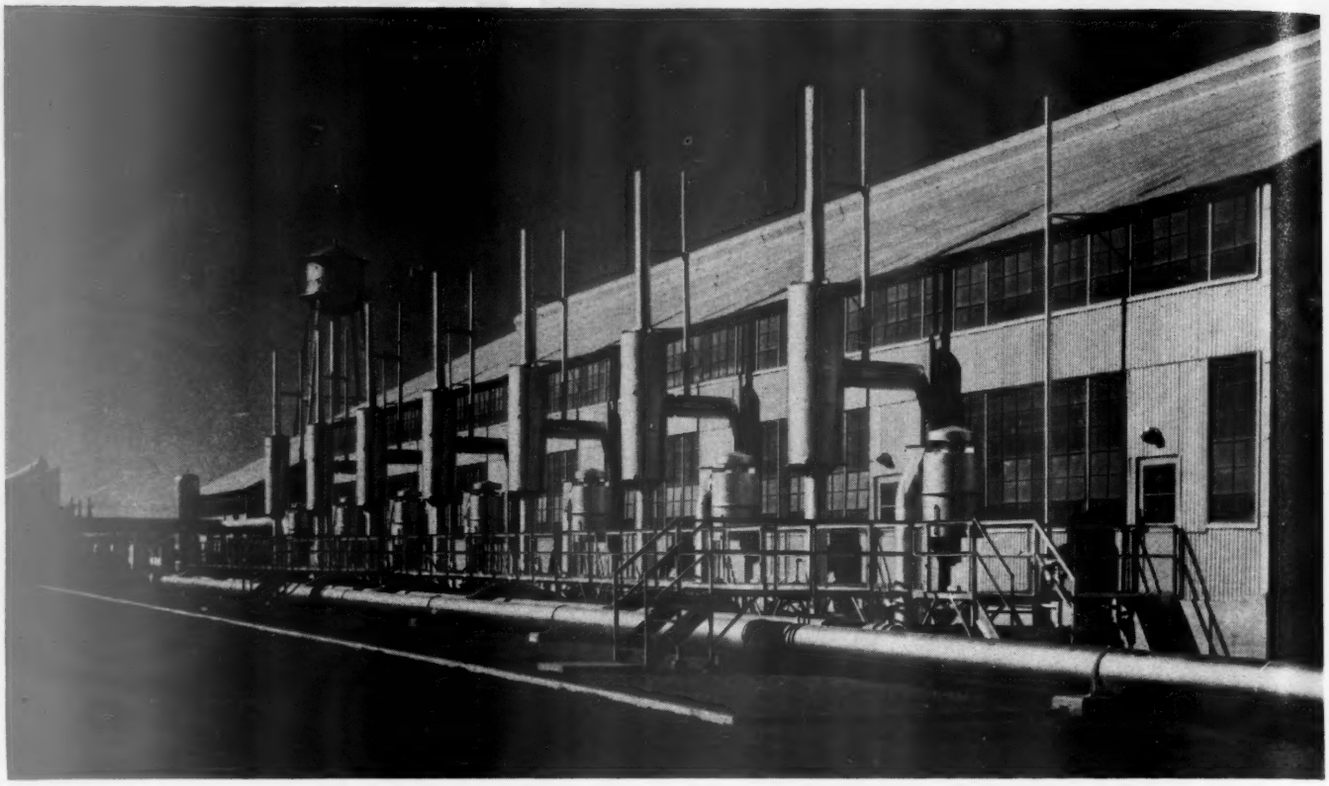
During periods of high winds shields were necessary to assure good welds and protect operators.



Windward side of shield prior to buckling canvas around pipe. Two welders operate behind shield.

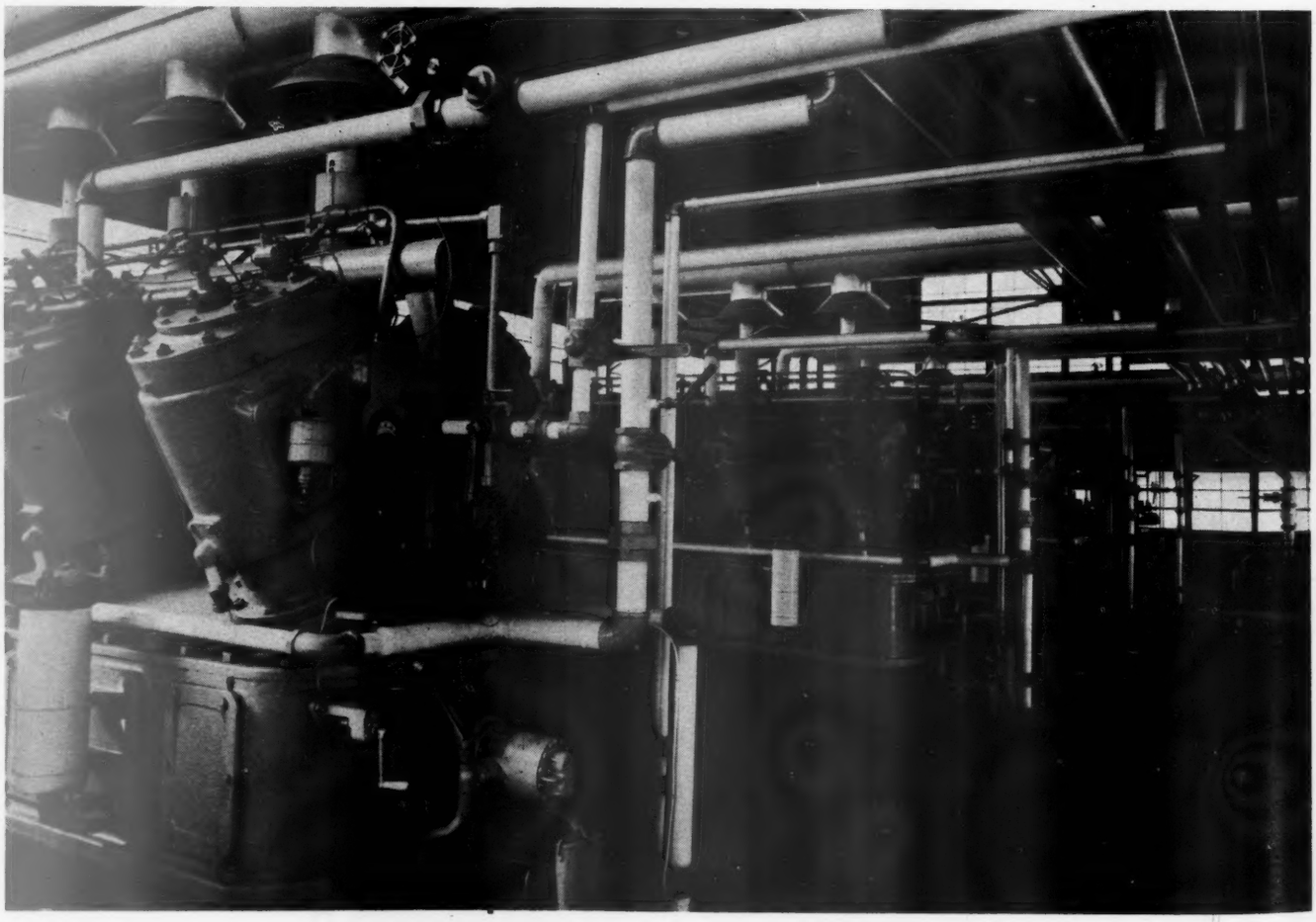


Missouri River Crossing at Rulo, Nebraska, on the Michigan-Wisconsin Pipe Line Company 24 inch gas line from Texas to Michigan and Wisconsin.



Exterior view of compressor building at Deming, New Mexico, station.

Gas engines driving 250-kw generating units at Fullerton, Texas, plant.



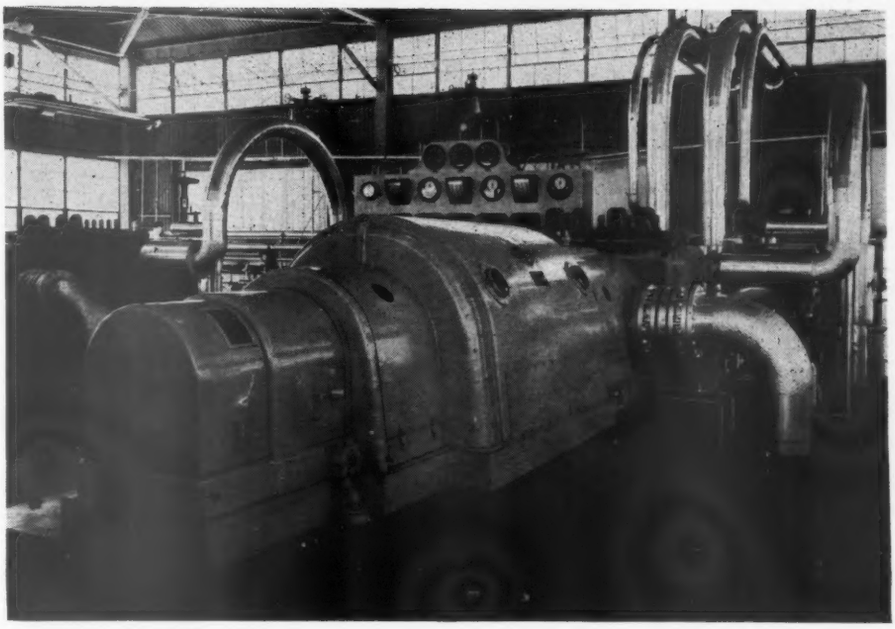
coated with a protective coating at the mill, this coating was removed.

Three welders were used in running the stringer beads, one acting as a relief. These welders were followed by the firing line welders, each of whom completed their welds. During cold weather "hot pass" welders were used immediately behind the stringer bead welders.

All welders employed on the project were required to pass qualification tests and periodic tests were made during construction. Customary nick breaks, bends, and tensile tests were made. Each welder carried an indentification stencil, marking his welds.

The high fall winds prevailing during much of the work made it necessary for us to build small structures that were moved along the pipe protecting the welders, thus avoiding many shutdowns. These shelters enabled us to maintain operations even in winds with velocity up to 20 mph.

Leakage records and tests made since completion of the project have shown an unusually high degree of welder efficiency with exception of one line. This line was a 5-in. OD with an 0.134-in. wall thickness. The pipe came in 24-ft lengths and had unusually bad ends that were not cut perpendicular to the pipe and not beveled. Various attempts were made to square and bevel the ends but all with unsatisfactory results. We found, however, that belling the pipe on one end and welding as bell and spigot pipe resulted in a satisfactory weld and practically eliminated all pin hole leaks previously encountered.



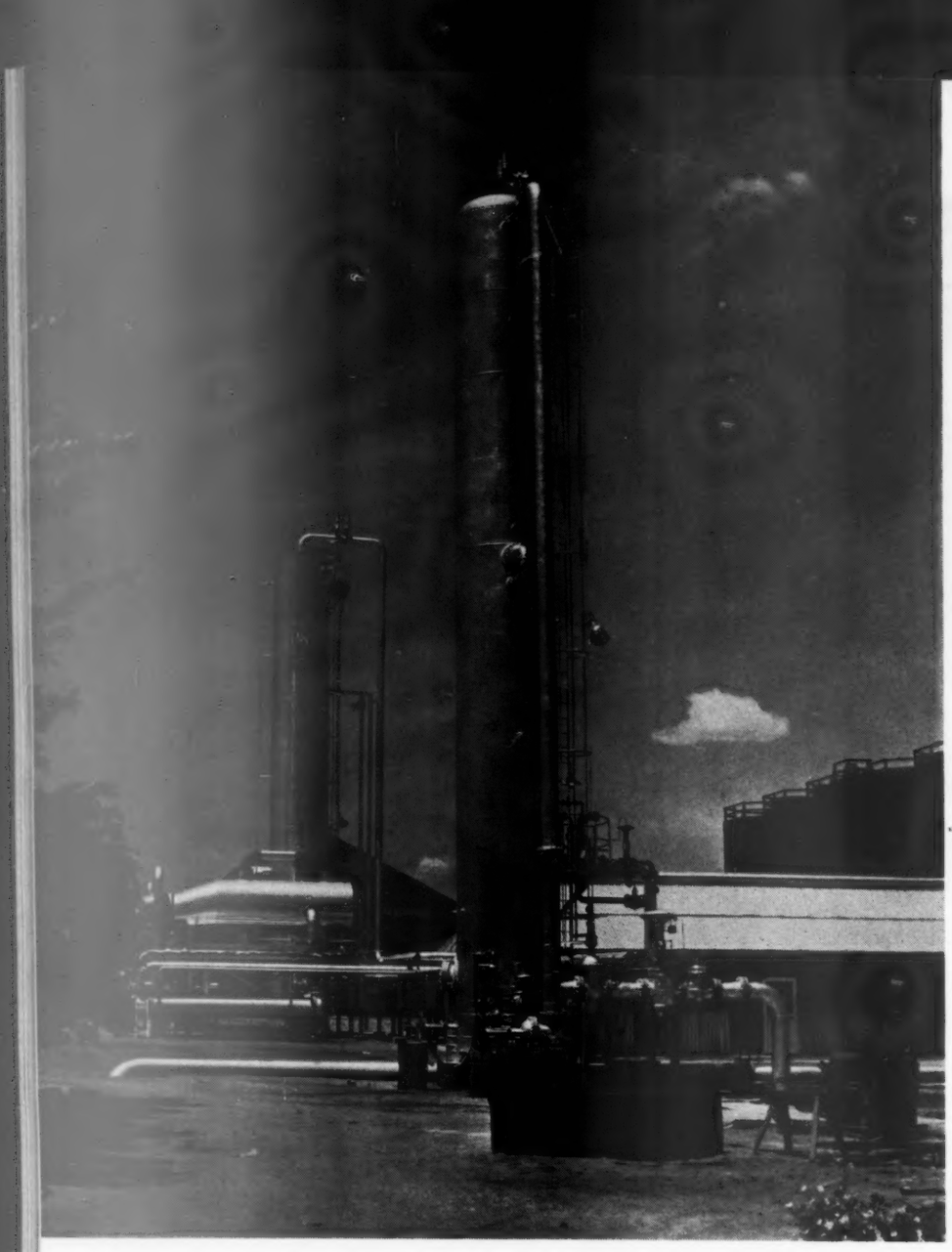
Extraction type turbo-generators at Eunice station.

Bending

The bends of the large diameter pipe were made by the cold wrinkle bending type machines. In sharp bends welding segments were installed. In laying the small-diameter pipe, bending shoes attached to the line-up tractor were used.

In rough terrain, it was necessary to have a bending gang consisting of five men, a sideboom tractor, and a bending machine in order to insure satisfactory progress. This crew measured, located, and made the bends well ahead of the line-up gang, thus removing the possibility of any delay

Compressors at Deming station are 1100 hp Turboflow units.



Purification-dehydration plant at Eunice, New Mexico.

in the operations of the crews following.

Cleaning, Priming, Doping

Traveling type cleaning, priming, and doping machines were used. The lines were all coated with cold tar pipeline enamel and wrapped with either kraft paper, glass mat, or impregnated asbestos felt, the various types of soil governing the kind of wrapper used.

Dope pots of 30-bbl capacity were used to supply the hot enamel. They were mounted on rubber tires and pulled along the line either by half tracks or trucks, depending, of course, on the terrain. The pots were cleaned and loaded with enamel at the railhead during the night and hauled to the right-of-way by trucks. The loading of the pots was expedited by means of a conveyor arrangement set up to load them.

Upon completion of doping and wrapping a section of the pipe, electronic holiday detectors were run along the line over the coating prior to the lowering-in operation. Any faulty doping or wrapping located by the detector was immediately corrected.

Lowering-In

The lowering-in operation was carried on in the usual manner and required four sideboom tractors on the 30 and 31-in. OD pipe. Slack loops were left at a rate of 7 or 8 to the mile. All lowering-in was done during the early morning hours to take advantage of the cool temperature prevailing at that time.

Backfilling, Clean Up

Both angledozers and backfillers were used in backfilling. Motor patrols followed the backfillers for final clean-up and road building. This crew also installed all diversions to prevent future soil erosion.

Purification-Dehydration

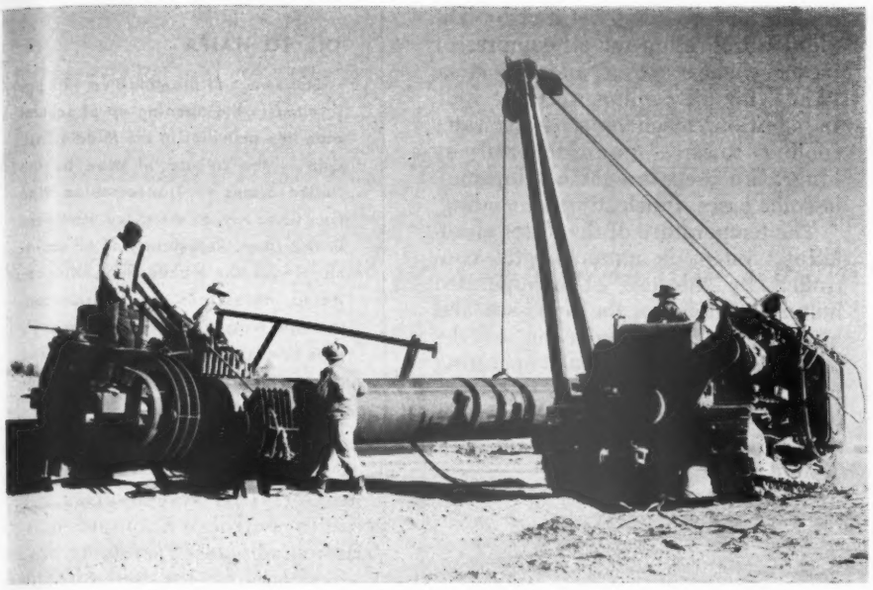
The demand for additional gas made it necessary to increase the purification and dehydration facilities during 1948. The Eunice, Jal No. 1, and Keystone plants were increased in capacity, the new plants in the Wasson and Goldsmith fields and at Dumas were constructed, the capacities being as follows:

Location	Capacity, cu ft
Dumas, Texas	75,000,000*
Wasson, Texas	72,000,000
Eunice, New Mex.	75,000,000*
Eunice, New Mex.	40,000,000
Jal No. 1, New Mex.	50,000,000
Keystone, Texas	60,000,000
Goldsmith, Texas	60,000,000

*Dehydration only.

The above represents an increase of 280,000,000 cu ft of purification and dehydration and 150,000,000 cu ft of dehydration only. Together with installations in operation prior to 1948, the combined purification and dehydration capacity has been boosted to 832,000,000 cu ft per day. All purification plants are of the modified Girbotol process (glycol-amine), in which the purification and dehydration is combined. The hydrogen sulphide content in the gas processed in these plants varies from a maximum of approximately 3000 grains per 100 cu ft down to gas containing 100 grains per 100 cu ft, and the carbon dioxide from a maximum of 7½ per cent to a minimum of 0.5 per cent, all of which has to be removed. This gas is purified to conform to the rigid California specification of not more than 0.25 of a grain of H_2S per 100 cu ft, 5 grains per 100 cu ft total sulphur, and is dehydrated to a dew point of approximately 35 deg at 825 psi.

Process steam is required in the Girbotol purification and dehydration process. The increased steam capacity for the above additional purification and dehydration facilities amounted to 175,000 lb per hr, ranging in pressure from 150 psi saturated steam to 225 psi saturated steam. This additional steam generating capacity brought the overall total steam generation capacity to 554,000 lb per hr. The largest boiler installation is at the Eunice, New Mexico plant, where three integral-furnace boilers are installed, operating at 600 psi, 600 F super-heated steam with automatic fuel combustion control. This 600-psi steam is reduced to 125-psi for processing in the purification plant, and this reduction is performed by 1500-kw non-condensing extraction turbine units. One turbo-generator unit supplies sufficient steam for the purification steam process when operated at



The men here are preparing to bend the 31-in. pipe.

full load. This is the only plant where steam is used at 600-psi pressure. The remaining purification plants, with the exception of Keystone, use process steam at approximately 220-psi saturated. At the Keystone plant the steam is used at 150-psi saturated. Electrical power is used to drive circulating pumps for the solution used in the Girbotol process. This power amounts approximately to 200 hp in each plant. By the use of indicating pressure and temperature gauges, and also recording pressure and temperature instruments, a close check is maintained on correct operation of the purification and dehydration process.

Compressor Stations

A total of 126,800 compressor hp was installed in the year 1948, part of which was additions (denoted by asterisk) to existing stations previously built for the California system. The size and locations of these station are as follows:

Main line stations

Gila, Arizona	11,000 hp
Tucson, Arizona	9,500 hp*
Willcox, Arizona	20,800 hp
Deming, New Mexico	19,800 hp
El Paso, Texas	13,800 hp
Guadalupe, Texas	19,800 hp
Eunice main line, New Mexico	6,000 hp*
Jal No. 1, New Mexico	800 hp*
Total	100,700 hp

Field stations

Dumas, Texas	7,000 hp
Keystone, Texas	1,600 hp*
Wasson, Texas	5,500 hp
Goldsmith, Texas	12,000 hp
Total	26,100 hp

Of the above, 5610 hp represents the increase due to conversion of previously installed Cooper-Bessemer GMV-10 units to Turboflow, manufactured by the same company. In addition to these GMV-10 units (1100 hp), GMV-6 (600 hp) and GMV-8 (800 hp) units are in use. Also, Clark compressor units are used in sizes ranging from the RA-8 (800 hp), BA-5 (1000 hp), BA-6 (1200 hp), to the

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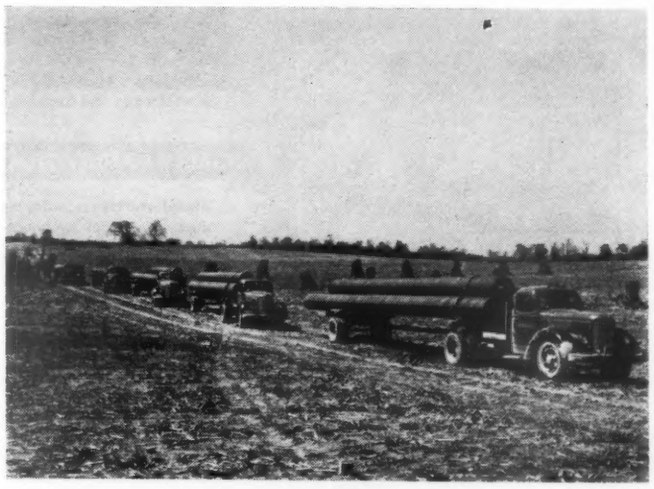

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BA-8 (1600 hp). Ingersoll-Rand KVG (1000 hp) units also are used. The original pipe line stations contained Cooper-Bessemer Type 19 horizontal, 4-cycle engines rated at 800 hp. The installation of these additions brings the total horsepower in operation for the pipe line system to 223,400. The design of these stations is of the conventional type, back-to-back arrangement, and side-by-side arrangement of engines. A few improvements have been incorporated in the design of new stations, such as the installation of piping aboveground, with the exception of drain lines, the use of air cooling towers manufactured by The Fluor Corporation for all compressor jacket water cooling and, in some plants, for oil cooling water as well. In addition, mechanical draft water cooling towers, manufactured by Fluor, are used for gas cooling and, in some cases, lubricating oil cooling.

The temperature of the water circulating system is automatically controlled by the use of air-operated butterfly valves on the bypasses and by automatically increasing or decreasing the number of fans operating in the cooling towers. This is accomplished by the use of a temperature controller. This system gives a temperature control of not more than 2 F variation. Enclosed systems for all types of cooling are used throughout in the new design. The extensive use of air-cooling towers (fin-fan) was primarily considered due to the extreme shortage of water in most of the station sites. Although installation of this type represents a substantial increase in first costs, the simplicity and economy of operation will soon justify the added expense. All the fans for these various air cooling towers are driven by electric motors. In order to eliminate annoying pulsation of the gas, which causes pipe vibration as well as a loss of horsepower, pulsation dampeners were installed in all compressor units.

The electrical power required by various motor drives and lighting throughout the plants is provided by gas engine driven generator units, and also turbine generator units. This generating capacity was increased 12,060 kva in 1948, making a total of 23,712 kva installed on the complete system. The gas engine generator units range in size from 62 to 500 kva. Various manufacturers' engines are used. Of the above-mentioned generator capacity 4370 kva is supplied by turbine generator units in two different sizes, one being 1500 kw direct driven, and the other 250 kw geared turbo-generator unit. Cooling of the gas engine driven generator units is accomplished in the same manner as that for the compressor units in the same cooling system. The latest design of switchgear has been used for the control of the generator units and power feeders, this being metal-enclosed draw-out type air circuit breaker switchgear. Motor control is accomplished by the use of motor control centers, where all motor starters for a particular installation are grouped together in one structure. This considerably simplifies the operation and maintenance of the electrical equipment. For pump and fan drives

OIL TO HAIFA

Settlement of the Palestine war has resulted in the opening up of several pipe line activities in the Middle East. One is the release of pipe by the United States to Trans-Arabian Pipe Line Company, as discussed elsewhere in this issue. Resumption of oil movement from the Kirkuk field, Iraq, to Haifa, Palestine, via Trans-Jordan, through Iraq Petroleum Company's pipe line is another outcome. The Iraq government closed the line at the outbreak of the war.

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Natasco Corrosion Prevention Service for storage tanks keeps new tanks new and makes old ones give additional years of service. Scientific preparation of all surfaces and application is performed by experienced Natasco Crews.
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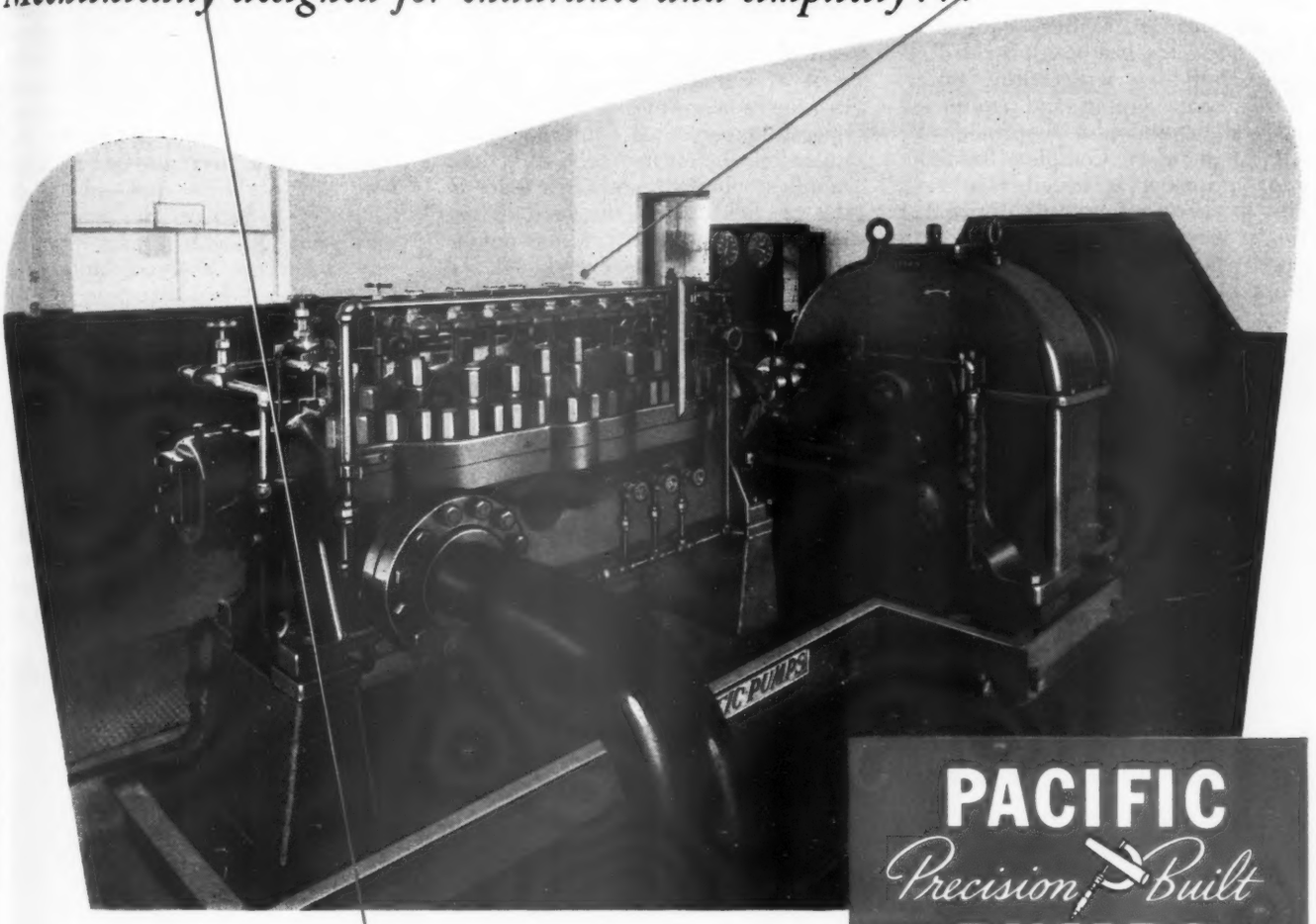

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Write for Bulletin 103 showing cross section with complete details of construction and performance.

PL-1

3-phase, 440-volt induction motors are used throughout. The lighting installation in the various buildings has been installed to provide approximately 10 ft candle of illumination, which is considered sufficient for operational use.

In the overall design of the various compressor stations considerable attention has been given to provide simplicity of operation, both in compression of the gas and in operation of the various auxiliary equipment. Ample spacing has been provided between buildings and cooling towers to eliminate piping and equipment congestion, and also to provide the utmost in safety. Complete fire-fighting equipment is installed in each station to combat any type of fire that might develop. This includes both water and chemical fire-fighting equipment.

The new main line compressor stations were designed to operate at a discharge pressure of approximately 825 psig, with a suction pressure of approximately 500 psig. The field compressor stations operate at lower pressure levels and contain two-stage compressors as well as single-stage compressors. Emergency shut-down systems were provided in each station, which automatically stop all compressor units, and, in the case of the main line stations, automatically close the suction and discharge valves entering and leaving the plant.

Employe Housing

One of the main problems confronting the company has been the providing of living quarters for the operating personnel. Most of the plants are so situated that adequate living facilities are unavailable in the vicinity. As an illustration, the Guadalupe compressor station is approximately 100 miles east of El Paso, Texas, and 60 miles west of Carlsbad, New Mexico, the two towns nearest to the station where operating personnel could find adequate housing for themselves and their families. Similar conditions exist in the gas field, where the surrounding towns are small and therefore unable to accommodate the several hundred men who are involved in operating these plants. In order to adequately house the men and the families manning the various plants that were constructed during the year 1948, 190 five and six-room houses were built, making a total of 442 houses for the operating personnel distributed among the various plants. Approximately 1200 sq ft of livable area is provided in the six-room house, and 1000 sq ft in the five-room house. These houses contain a single car garage, as well as a service porch. They are of frame construction with asbestos siding and asbestos shingle roofing. Particular attention has been paid to the layout of the houses in the various station camps, taking into account the prevailing breeze and also providing adequate yards. Planned landscaping is provided at each station camp, using shrubs, trees, and plants to fit the particular location.

Due to the remote locations of these plants, special attention must be given to provide the operator and his family with as many of the city conveniences as possible, including the procurement of schooling facilities for the children and recreational facilities both for children and adults. At Guadalupe station where there are an estimated 40 children who must receive schooling, a school building is in the process of construction with an ultimate capacity of 65 pupils. There are two other compressor stations where such facilities have had to be provided; others are somewhat more fortunate in having established schools within a radius of 25 miles or less. In this case transportation is provided for the children from the camps to the schools. It is felt that comfortable living conditions and adequate recreational facilities have been provided for the operating personnel. ***

977

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The 66 employees of Latex Construction Company participating in our Employees' Retirement Plan during 1948 (eligibility requirement: 5 years or more continuous employment) have a combined total of 977 years of pipeline construction work. These years of experience and specialization are reflected in the efficiency of Latex pipeline construction.

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General Contractors

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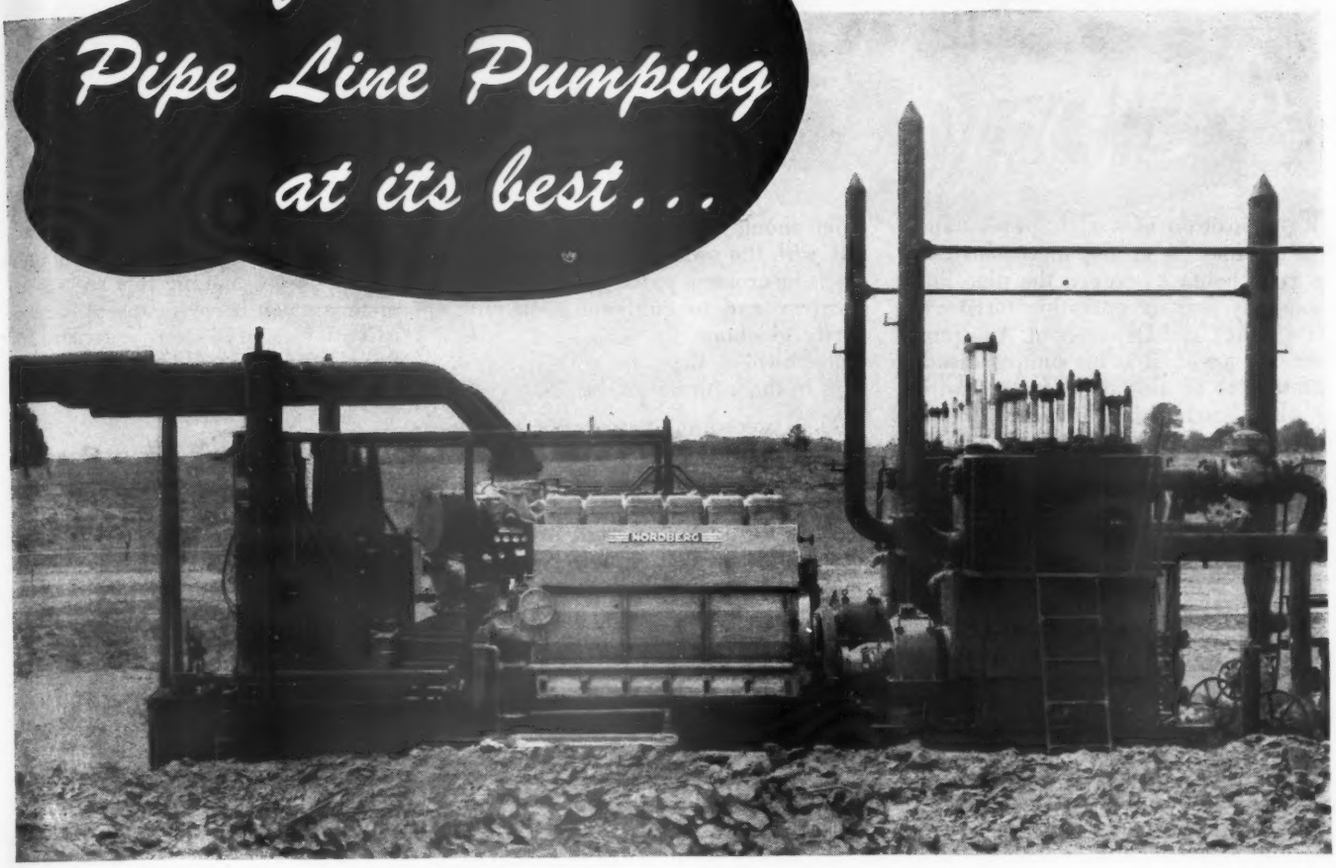
Shown here are two 9" x 11½", 6 cylinder, four-cycle, supercharged Nordberg Diesel Engines driving six inch quintuplex pipe line pumps. These engines develop 375 to 400 H.P. at 600 R.P.M.



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THE position of a right-of-way and claims man is at the most sensitive area of contact between the pipe line company and its operating territory. His is the Grief Department. As a purchasing agent, it is his unique disadvantage to be always confronted with a sellers' market in which the persons from whom he must buy have been specified beforehand by a process that takes no account of their readiness to sell. With very rare exceptions a pipe line location is made on other considerations than the ease of procuring right-of-way.

The normal procedure is this: After all the complex gear-train of company organization has been set in motion upon a new project, the proposal designed by engineering and approved by management, bids procured and the contract awarded, pipe in transit from mill or warehouse and the contractor's crews beginning to assemble, then the right-of-way man is suddenly thrown into gear with the full momentum of a going operation. It is his function to engage, by written contracts, all the disparate and often obstinate cogs of landowners, tenants, heirs and assigns, or mortgagees, who have a legal interest in the land to be traversed by the pipe line. Engineering provides him with a map and a right-of-way list, and the monkey is on his back.

Not the reading of one easy lesson, nor the study of an entire library, can turn out a good right-of-way man but a few observations might be of value to the men in the smaller companies, engineers, material men, district supervisors, etc., who only occasionally are obliged to take on the job of buying right-of-way, and to young men in the major companies who should have some familiarity with all the procedures of pipelining.

Our man, then, has his right-of-way list, usually prepared by the chief of the survey party after each day's work. It gives the station numbers at which the surveyed alignment enters and leaves the properties of every landowner, with the distances in feet and rods across each tract. It is not always entirely correct. Although the party chief should have made an effort to talk with the owners or tenants of the tracts he crossed, partly as a matter of courtesy and to cultivate good will, partly to obtain the addresses of absentee owners, there are usually a few gaps in the information he can give.

The preceding paragraph might suggest that the life of a right-of-way man is made sweeter when he enjoys the cordial cooperation of the engineer on the job. The truth of this is often demonstrated, in reverse, by a mutually distrustful irritation, the right-of-way man feeling that the engineer doesn't take seriously enough the prompt transmittal of line lists, described right-of-ways, etc., whereas the engineer is convinced that all right-of-way men conceal their own shortcomings by beefing to headquarters about imaginary failures in cooperation. As usual, the facts are somewhere midway of the two contentions. You are not expected to plead with the engineer for the data you need, but it is a mistake to suppose that he is going to give your requirements a top priority among his other headaches if he thinks you are not "regular."

The same warning applies to your relations with all other fellow employes whose interest in your troubles can do a whole lot toward easing them; the district supervisors, gang foremen, pipe line inspectors, etc. Even when they are aware of duties toward the right-of-way department they are not apt to extend themselves very far unless you enjoy their liking and respect. The way not to enjoy those is to get yourself a real high hat and wear it all the time.

Before calling upon a landowner for the purpose of buying right-of-way it is a wise precaution to look over the surveyed alignment, particularly where the route lies across cutivated ground. If the engineer has not given you that information, as he should have, note the station numbers at which the survey enters and leaves the various types of cultivation, at the same time forming a rough idea of the condition of the crops that are likely to be damaged by construction. While you are making this reconnaissance you can leave a copy of the line list with a local abstract company for the preparation of title certificates, and make arangements for a notary public to accompany you next day.

If at all possible, get the services of a notary from some locally respected law firm; best of all, for a number of reasons, would be the engagement of one of the attroneys even though the fee is considerably larger. It is assumed that you have faith in the fairness of the contracts you want signed, and in the integrity of the company you represent. If you can communicate that faith to the attorney, and if his own honesty is known to the community, you will be able to close your deals with much less delay than if you had economized on notarial fees by taking along just anyone possessed of a notary's warrant. This will be especially true when dealing with cautious landowners who might otherwise insist on submitting the right-of-way contract to their own lawyer's examination before signing. At best, this step would delay your purchase by a day or so. At worst, if business happened to be slack with the lawyer in question, he might feel inspired to re-write the contract for his client, including clauses inacceptable to your company, which could lead to protracted negotiations and a week's delay in the construction schedule.

The interview is the pay-off. Remember that high-pressurism went out with the buggy-borne lightning-rod salesman, and that you are not working on a "single-shot" deal; after the pipe line is laid you are apt to have a great many traffickings with this man. There may be loops to put in the line, reconditionings and replacements, oil leak claims to be settled. Don't make loose, extravagant promises, that can return to haunt your future dealings just to speed up your immediate purpose of getting the man's signature on an easement contract.

At least half of the landowners, even though willing to sell you the right-of-way, are going to be dissatis-

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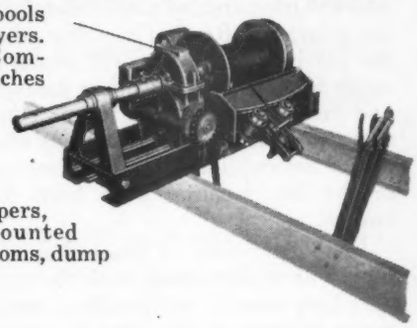

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fied in some particular with the route across their land. That is why you should be as familiar as possible with the alignment. If you call him "cold" you can not be very convincing in rebutting his objections.

"Why," he might demand, "Couldn't you swing up above that dirt water tank and miss my oat field? I'd like to accommodate you people and I'll take Judge Smith's word for it that your contract's okay, but it'll be a month before I'm ready to combine those oats, and way you're going you'll ruin a couple of acres right in the middle of the best stand I got."

Having looked the line over before talking to him, you don't have to go into a clinch.

"Well, sir, we don't like to put a pipe line right up-stream from a stock pond. We take very precaution we can to protect that line, but accidents sometimes happen and you nor us either want to get any oil in your stock's drinking water. Now, the line is in your oats for exactly 485 ft, call it 500. We'll see that the contractor's crews stay in as narrow a strip as they can work in, but they're going to trample down about a strip of 30, 35 ft wide. Not more than forty. So that makes just under half a acre of your crop would be damaged. It's a nice looking crop, all right. What do you get off it? About 30 bushels to the acre?"

Make your guess on the generous side. If the man is honest, it will make him feel good inside to correct your estimate; if he's not honest it will make him feel good to think he's going to rook you out of a few bushels of oats, and you will have learned something at small cost. In either case, you will have given him a pleasant feeling and will have created a diversion from his grievance. Remind him that when the job in finished you will return to settle for all crop and other damage, and then encourage him to talk some more about his crops or anything else, on the assumption that his objections to the line location have been answered.

In the majority of cases that will be all of it, but sometimes the man does have sensible and stubborn arguments in favor of changing the alignment. Maybe the survey party could have missed his tomato patch by backing up and swinging 50 ft to the left to parallel a field fence, without lengthening the line more than a couple of rods. You know that one oil leak in the present location would cost more than the revision in the route, but you have no authority to promise him the changed location. If you can't buy the right-of-way, as staked, let it alone until you have talked it over with the engineer on the job. Here is a test of the mutual respect and cooperation between you. All engineers are reluctant to "back up" and alter a staked alignment, so don't request it unless absolutely necessary. To you, a good pipe line location is one that is easy to buy, but the engineer gives that consideration a minimum of thought, and the more headaches you bring him the more minimum it will grow.

If the right-of-way you are buying lies in an area of active oil play you will usually have a big edge in your favor because the landowner naturally expects to profit by the development, and will look more kindly on persons connected with the oil industry. He will unless he has sold all his royalty interest at a low price. That's a point you should have previously checked, since it would not be helpful for you to rub salt in his wounds by "popping off" about the wonderful prospects for oil upon his land when he no longer has any claim upon that oil and probably hopes there isn't any.

It has been considerably emphasized in company house organs and other material addressed to employes that in their dealings with the general public the company's reputation for fair dealing, or the reverse, is established. To no one is that fact more important and applicable than to you, as a representative of the Right-of-Way and Claims Department. Since it is you, an individual, who are asking his signature to a contract, the landowner wants to consider you personally responsible for your company's discharge of its part of the obligation. Encourage him to do so. Tell him frankly that despite all the care and precautions of company foremen and inspectors it is possible that some cause of complaint might arise, and that you would appreciate it if he would notify you in the event it did. Leave him your card with the assurance that he can reach you, long-distance collect, if his cows get out, or the contractor makes a bad job of fence replacement, or the backfill interferes with his plowing. A farmer's irritation over these mishaps is often aggravated by his trouble in getting somebody to take the responsibility for them. Your company's reputation will bloom, and your future work in that community be greatly facilitated, if you make it clear beforehand that there wil be no "buck passing" on his complaints.

This, of course, is where your cordial relations with the construction personnel pay off. In most pipe line construction contracts there are minimum requirements for tidying up the right-of-way, disposing of debris, noninterference with natural drainage, etc., which it is the duty of your company's inspectors to enforce. The enforcement is sometimes perfunctory, and when the landowner has made special conditions on the way he wants the backflll left, or on the staking of brush from the right-of-way, it will not be enough for you simply to announce to the chief inspector that thus-and-so is the way you want it done. Save some of that diplomacy you're supposed to have for use with your fellow employes.

As to the order in which you call on your prospects, it will usually be advisable to sew up the big tracts first. There are two reasons for this: The big landowner will probably be of some influence in the community so that doubting, hesitant neighbors find assurance in the fact of his agreement; second, on some of the smaller tracts, containing perhaps some 20 or 30 rods of right-of-way, the payment at average rates of about 50 cents per rod is so small in amount that there is not much inducement for the owner to sign, and there may be considerations of nuisance effect that would justify you in paying a much higher unit price for the few rods involved. If you have been obliged to pay two or three dollars per rod across some small, difficult blocks, however, you will find that the word has spread, and when you call upon the big owners they will have that price in mind for the several thousand rods of line upon their lands.

For somewhat similar reasons, if

The Authors

A native Texan, Charlie Wilson was born in Harris County in 1909. He worked at many jobs before becoming a pipeliner with Humble Pipe Line Company at Bruni in 1935. Since 1936 he has been stationed at Corpus Christi, headquarters for Humble's Southwest Texas Division, except for three and half years active duty with the U.S. Corps of Engineers in the European theatre, from which he returned with a Reserve rank of Major. During his service with Humble he has been warehouseman, timekeeper, assistant division chief clerk, and is now division claim and right-of-way agent.

Born in Paris, Texas, in 1904, Peyton Bryan went through elementary school in Dallas and was graduated from the old Central High School of Fort Worth in 1922. Following two years' vague pursuit of Eng. Lit., For. Lang., and Anal. Geom. at Texas Christian University he spent several vague years in sea-faring, etc., before joining a Humble Pipe Line Company survey party at Longview in 1933. Like Wilson, he has been in Corpus Christi since 1936, and he has been division engineer for a year or so.

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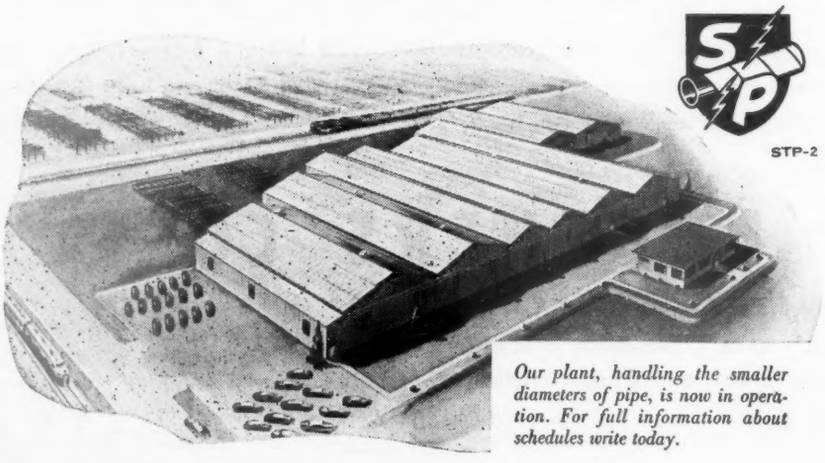

STP-2

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you have upon your list a man whom you know to be obstreperous it is better to leave him alone until you have closed your other deals. On every line there is established, and quickly made known over the community grapevine, a roughly average price for the right-of-way. By getting that price established in your dealings with more reasonable men before calling upon the crank you have a chance of moderating his demands. Even if they are still exorbitant, but your company prefers to meet them rather than to condemn, you will have provided most of the right-of-way at a reasonable cost. Had he been among the first you dealt with you could certainly have expected the price to sky-rocket on any remaining tracts in the neighborhood.

Another expectation of which you can be assured is that the job of the right-of-way representative will continually grow more difficult and demanding. The oil industry in general has been shocked by the results of opinion surveys that indicated a suspicious public attitude toward us all. Probably a fair proportion of the responsibility for this ill-favor is due to the haste with which oil-field projects seem always affliated.

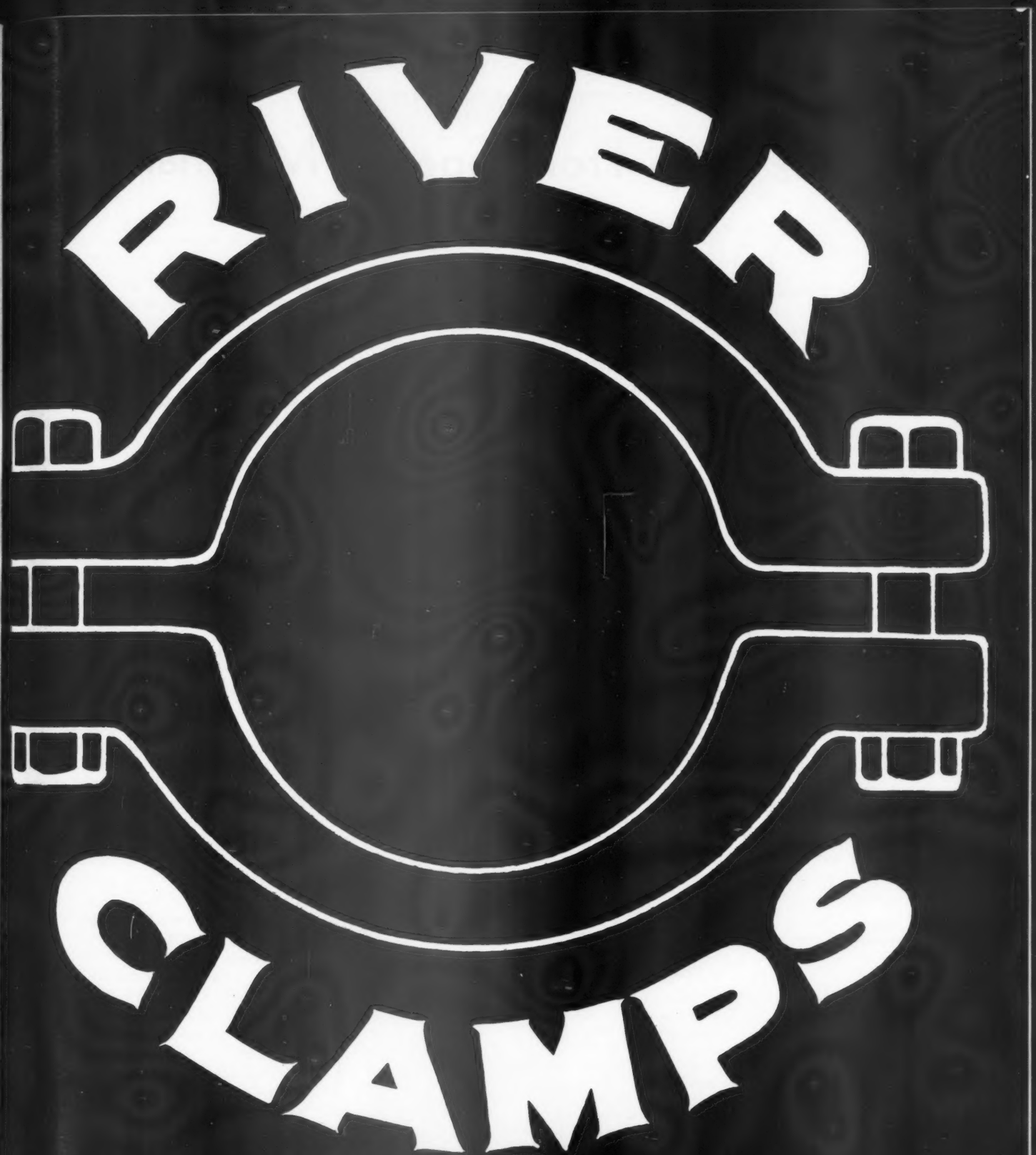
MICROWAVE SYSTEM

A microwave radio telephone communication system, such as described by W. T. Bulla in the article on page D-16, will be installed by Keystone Pipe Line Company. Authorization has been given for the first five stations of what is believed will be the first microwave system in the United States and the first for the petroleum industry. Initial facilities will serve the pipe line for a distance of 75 airline miles. Eventually the system will extend through Pennsylvania, New York, and Ohio.

"Get the job started on Monday," says classic pipe line directive, "and take all the time you need, just so you get flanged up by last Wednesday."

Under that stern prodding the men in the industry have won considerable acclaim for the energy and ingenuity of their attack on physical obstacles. Unfortunately, in the solution of human problems, i.e. in dealing with a public that is indifferent to our necessity for getting flanged up by last Wednesday, that same impatient energy and ingenuity has sometimes led a right-of-way buyer into the attitude of a carnival barker whose job is to "talk 'em into the tent, and then let 'em squawk all they want to."

To do your job properly, you will not only have to get them into the tent but keep them satisfied with what they find there. ***



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HOUSTON, TEXAS

Line Pipe From Special Materials

W. R. FINNEY

STEEL has been the material customarily used in making pipe for petroleum pipe lines during the last 50 years. The scarcity of steel during and since the second world war, however, has brought about some consideration of the desirability of making pipe from other materials for special uses and in this manner alleviating the shortage to some extent.

The present scarcity of pipe for oil country use has been made more acute by the large gas line program, which was held back during the war period.

A consideration in addition to the factor of shortage, is that the special pipe could be used when constructing lines through difficult terrain such as swampy ground or extremely rough country where light weight would be advantageous. A saving in weight also would be helpful when laying emergency or temporary lines.

Pipe made of special materials might also eliminate or reduce corrosion and thus find application to service in the sour crude areas such as West Texas and Arkansas.

Joints a Problem

For general use in petroleum pipe lines special pipe has been costly, lacking in strength, and unsatisfactory in the matter of welding or coupling the single joints into a continuous line. The many advantages of a smooth circumferential weld strong as the pipe itself are recognized by all experienced pipe line engineers.

The item of initial cost needs little explanation and must be overcome through more development and the use of mass production methods in making new types of pipe. The matter of strength might be overcome in various ways such as greater thicknesses or different reinforcing materials.

Some means of coupling or joining the separate lengths in the field that will be as reliable as the welding of steel pipe, seems to be a problem more difficult of solution, especially for nonmetallic materials. Most of the special types of pipe have been offered with a friction or sleeve type coupling, which would not be satisfactory for high pressure petroleum service because of low joint strength and lack of complete and permanent tightness. Threaded joints are suggested in some instances but this method is out of date.

At least one type of plastic pipe now on the market can be "welded" by softening the ends with heat, joining the pieces together, and then cooling the circular seam, but other characteristics of this pipe make it unsuitable for pipe lines.

Pipe Materials

Since the war some aluminum pipe has been manufactured and a few miles of 4 and 6-in. lines are being tested by one pipe line company. This metal can be welded in the field and a commercial alloy available has a yield strength comparable to Grade B steel pipe.

Aluminum pipe of the same dimensions as steel pipe weighs one-third as much but its cost is greater. For a 6-in. line it has been estimated that with freight and other savings due to the lighter weight the aluminum line would cost about twice as much as a steel line. Therefore, the use of aluminum at the present can be justified only under special conditions such as, perhaps, sour crude operations. Tests now under way will in time determine whether or not aluminum pipe is satisfactory for special oil field use.

Glass has been suggested for use in making pipe, as theoretically, from physical considerations, it should have a higher tensile strength than steel but actually due to surface imperfections it has less strength. Glass with a working tensile strength up to 13,000 psi, weighs about one-third as much as steel, and is resistant to corrosion. but fairly brittle. Glass pipe could probably be made at reasonable cost; however, no satisfactory method for joining glass pipe together has yet been devised.

Various cement and plastic impregnated fiber pipes are being made. Asbestos fiber cement pipe is corrosion resistant and has many uses but is limited for petroleum lines because of its low strength and joint limitations. Asbestos pipe has a low tensile strength and is limited in use to pressures not in excess of 200 psi.

Plastic impregnated plywood pipe also has been suggested. Such pipe is said to be as strong as steel, lighter. and more corrosion resistant. The joints are again a problem even though the material can be threaded and machined.

Unreinforced plastics have been used for small diameter pipe. Such pipe is corrosion resistant but not too

EXCLUSIVE

THE AUTHOR

W. R. Finney

W. R. Finney, pipe line advisor to Standard Oil Company (New Jersey), has been associated with the oil industry for about 35 years. He was graduated from Stanford University in mechanical engineering in 1912. His first oilfield experience was in California. In 1917 he moved to Oklahoma where he designed and built gasoline plants. The next year he joined Midwest Refining Company and after 11 years in Wyoming was transferred to New York to supervise Lago's electrification program in Lake Maracaibo, Venezuela. In May, 1932, he was transferred to Jersey Standard's producing department. He became president and a director of Oklahoma Pipe Line Company and vice president of Ajax Pipe Line Corporation in July, 1936, and moved to Tulsa, where he also served in an advisory capacity to Standard Oil Company of Louisiana's pipe line department. Three years later he returned to New York as a member of the producing department of Jersey Standard to coordinate operations of several domestic pipe line companies. He was made president of Portland Pipe Line Company May, 1941. In the fall of 1943 pipe line work was separated from the producing department and the office of pipe line advisior created. Finney now serves in a consulting capacity to 15 natural gas, gasoline, and oil pipe line companies and acts as advisor to Jersey on pipe line matters—both in foreign and domestic fields.

Finney is vice president and director of Interstate Natural Gas Company, Inc., and a director of McKamie Gas Cleaning Company, Plantation Pipe Line Company, and Interstate Oil Pipe Line Company. In January, 1948, he was named alternate director of Middle East Pipelines, Ltd., and is assisting on the plan of Middle East, Iraq, and Trans-Arabian projects.

strong, tensile strengths being 5 to 10,000 psi. Some of these materials can be "heat welded" and others cemented but none is developed for use in the larger petroleum pipe lines.

Concrete pipe, both plain and reinforced, has been suggested for petroleum lines but unsatisfactory joints have eliminated this material from serious consideration.

Graphite pipe of small diameter is made and used for handling certain corrosive fluids but does not possess the strength required for petroleum lines.

Plastic impregnated glass fiber or glass cloth pipe has been made and, except for joint considerations, has favorable qualities. It has a high strength-to-weight ratio and a tensile strength of about 30,000 psi. Glass fiber pipe has high resistance to shock and fatigue and except for alkaline solutions has good anti-corrosion qualities. This pipe has a cost disadvantage, however, as at the present time it costs about ten times as much as steel on a weight basis or three times as much on a per foot of pipe basis. The suggestion has been made that the ends of such pipe might be left semi-cured so that semi-cured coupling material could be applied with final curing taking place in the field to make a tight and strong joint.

RESOLUTION OPPOSES MORE GAS LINES FROM TEXAS

A resolution has been introduced into the Texas legislature asking the Railroad Commission to oppose additional pipe lines to move gas from Texas fields into other states.

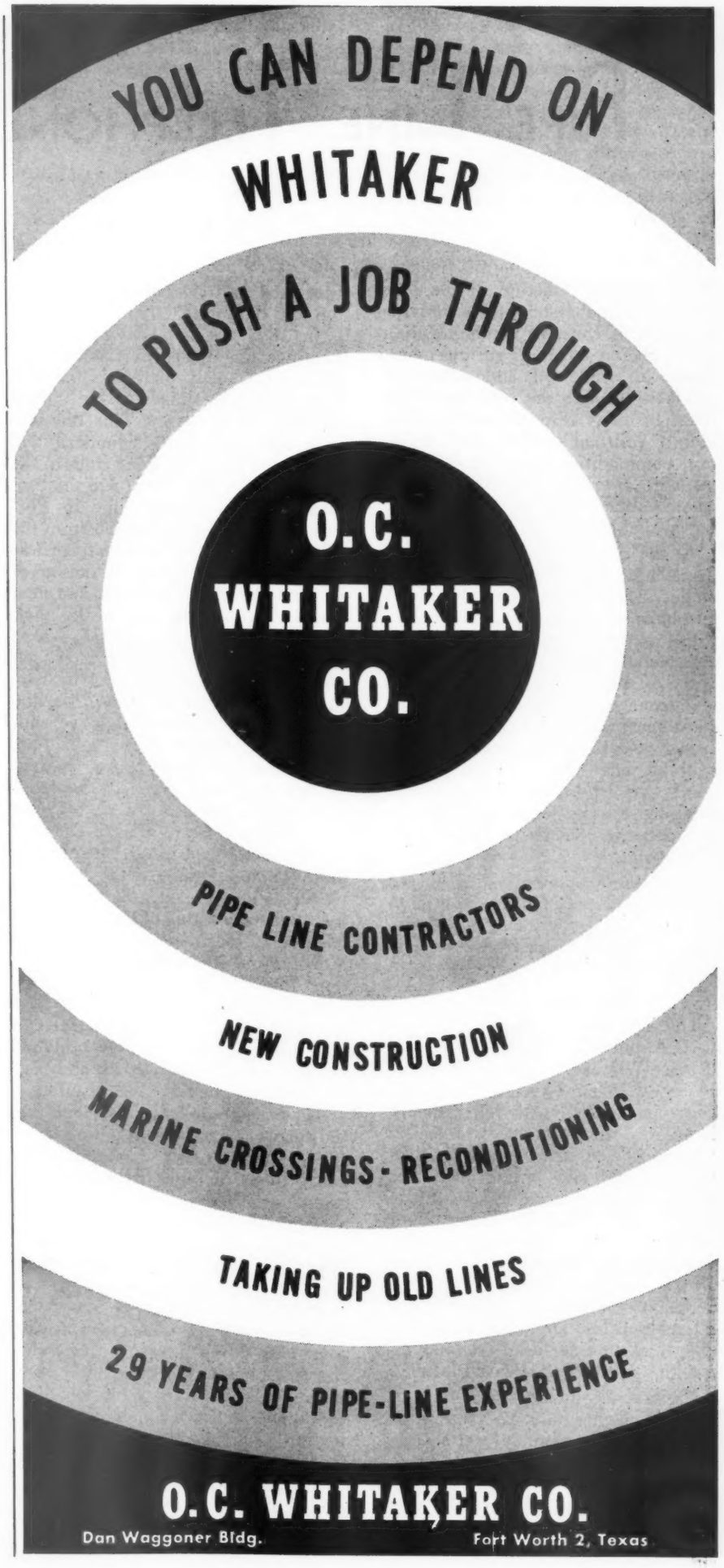
"The natural gas reserves of this state, vast and rich as they are, are not inexhaustible," said Rep. W. R. Chambers, who introduced the resolution, which has been referred to the committee on state affairs.

The resolution further requests the Railroad Commission to provide the legislature with an estimate of reserves and a report on previous production, "whether used or dispatched, so an intelligent state policy concerning use and production of natural gas may be established."

Conclusion

Information on pipe made of special materials is meager, and although certain developments and field tests are being carried on, their use in petroleum pipe lines is limited. The reason for this is due primarily to the failure, so far, to devise an absolutely tight and strong joint that can be made in the field during construction of the lines across all types of country.

* * *



PIPE LINE TELEPHONE SYSTEMS

W. E. CHURCH

THE primary function of the pipe line telephone system is to provide a means of constant communication necessary to control the various movements of crude oil and petroleum products through the pipe line. Pipe lines, in many respects, are comparable to railroad systems. Both transport commodities for great distances through sparsely populated areas where public communication lines are not available.

At the central control point in the dispatching office there is a dispatcher on duty 24 hours every day. By private telephone system he maintains contact with those men in the fields who handle the gauging, sampling, and testing of the oil, operation of pump stations, maintenance of pipe lines, etc. The dispatcher issues detailed operating orders covering each phase of the operations, and receives by telephone hourly reports from field gaugers, pumping stations, receiving terminals, and refineries on the progress of oil movements.

Thus, the telephone system is seen as a nerve system, highly essential to the successful movement of the millions of barrels of oil transported by pipe line.

The Early Days

The need for telephone service in the oil industry has existed since "Colonel" Drake drilled the first discovery well at Titusville, Pennsylvania, in 1859. Yes, perhaps the Indians, who used petroleum some 100 years earlier, though they did not drill for it, would have appreciated this modern convenience. Think of the valuable time Chief Powhatan might have saved by telephoning Chief Whitehorse for a pony-load of oil to mix his war paint, or as medicine for the papooses. Unfortunately for the Indians and Mr. Drake, Mr. Bell did not get around to his epoch-making invention until some 17 years later.

The first oil pipe lines were built in Pennsylvania in 1865. By the end of the 1870's there were several sizable pipe line systems in operation. Their only means of wire communication for dispatching pipe line orders was Morse Telegraph. Telegraph at that time was a new science, having been first used in 1844 between Washington and Baltimore.

In 1897 the first paying well at Coalinga was drilled by Canfield and Chanslor. Shortly thereafter the first California pipe line was built from Coalinga to Monterey. This line was soon followed by the Standard and Associated Oil companies' lines to the San Francisco Bay Area, and the Producers' Transportation line to Port San Luis. The first pipe line from the San Joaquin Valley to the harbor was constructed by Captain Barneson of General Petroleum in 1913, and next was the Valley Pipe Line of the Shell Oil Company, built in 1914. These pipe lines, and the more recently constructed ones, were followed by telephone and telegraph lines. Pipe line telephone circuits were equipped with magneto telephones of the wall type, with cranks on the side for ringing. Telegraph circuits were superimposed over the two telephone wires by what is known as "Simplexing." The two wires were looped into each intermediate pump station where switches were provided for opening the line to facilitate the locating of trouble. These telegraph circuits were equipped with Morse keys and sounders, and required Morse operators at each point where telegraph was used.

The discovery of Santa Fe Springs by Union Oil in 1919, Huntington Beach by Standard in 1920, and Signal Hill by Shell in 1921 caused a boom in activities in the Southern California area. The resulting telephone traffic greatly overloaded the long distance facilities of the telephone companies. Toll service between the fields and Los Angles, where most of the major companies had established offices, was very unsatisfactory. It was often necessary to wait as long as an hour or more for a call to be completed between these points. This lack of adequate long distance service caused the oil companies to construct their own telephone lines, not only for pipe line operations, but also for drilling, production, and refinery use. Switchboards and telephones were installed in fields and refineries. These facilities, connected by way of the pipe line circuits to switchboards in the Los Angeles offices, and thence to the circuits from San Joaquin Valley, completed the nucleus of the present California pipe line telephone systems.

THE AUTHOR

W. E. Church has been engaged almost continuously in work on pipe line communications systems for the past 26 years. He began with Shell Oil Company, Inc., as a lineman in the pipe line department in 1923, became telephone foreman a year later, and in 1938 was elevated to superintendent of telephones. He is now supervisor of telephone and telegraph communication, to which position he was appointed in 1948.

In the late 20's the Morse telegraph equipment was replaced by teletypewriters. The Morse operators were converted, much to their displeasure, to teletypists. This new telegraph equipment, however, had come to stay, and has proved capable of transmitting several times the traffic that was possible with Morse keys.

Carrier Circuits

In the middle 30's carrier current circuits were installed between Los Angeles, San Francisco, and other locations. Carrier current telephone is a method whereby several additional telephone or telegraph circuits are derived from one pair of wires by use of frequencies somewhat higher than the voice frequency. This apparatus, which requires considerable electronic equipment, has been referred to as wired radio, which probably describes it best to the layman. By the use of carrier current frequencies it is quite practical, at the present time, to obtain as many as four additional voice channels, or 32 additional telegraph channels from one two-wire telephone circuit. Maximums will possibly be considerably increased by future developments. This method of transmission has greatly increased the value and efficiency of long telephone lines.

EXCLUSIVE

One telephone circuit, through the use of carrier current channels, not only provides as much capacity as was formerly possible with four or five wire circuits, but also provides a better and more reliable service. Carrier channels will often work satisfactorily with one wire of the circuit broken down, grounded, or crossed with another circuit, whereas such conditions would render the conventional type telephone circuit unusable.

Construction cost to provide multiple telephone channels is reduced from 50 to 75 per cent through the use of carrier frequencies. Operation and maintenance costs are reduced in proportion.

Electronic Facilities

Teletypewriters, carrier current, and other electronic facilities have increased the traffic handling capacity and the transmission quality of pipe line telephone systems until they are now capable of handling a great portion of all telephone business between fields, refineries, offices, etc. These communication facilities have been increased until the name "Pipe Line Telephone System" has almost become old-fashioned. When used for pipe line operations only, the derivation of the name was apparent. Nowadays, people unfamiliar with the origin of the name sometimes ask, "Is it true that pipe lines are used to talk through?" This question is not really as ridiculous as it may sound. Experiments have been made utilizing the pipe lines as conduit to carry the telephone wires, and as a conductor for the voice currents, but with very little success.

The average pipe line system today consists of from 10 to 20 dial or manually operated switchboards, with a total of several hundred to several thousand telephones. The outside plant, consisting of cable, open wire and carrier frequency circuits, would be sufficient to provide telephone service for a city with a population of 20,000 or 30,000. The telegraph equipment generally consists of numerous teletypewriters and auxiliary apparatus capable of handling hundreds of messages per day.

In addition to telephone and telegraph, many circuits for other purposes such as code call circuits, supervisory circuits, fire alarm and control circuits are installed and maintained on spare cable and open wire lines.

From the above it is seen that the pipe line telephone system has grown somewhat like "Topsy." Each small extension has been made only as necessity required, on a pay-as-you-go basis. That is, each extension of line or installation of equipment has been justified on an early return of invested capital through reduction of operating expense by greater use of telephone communication.

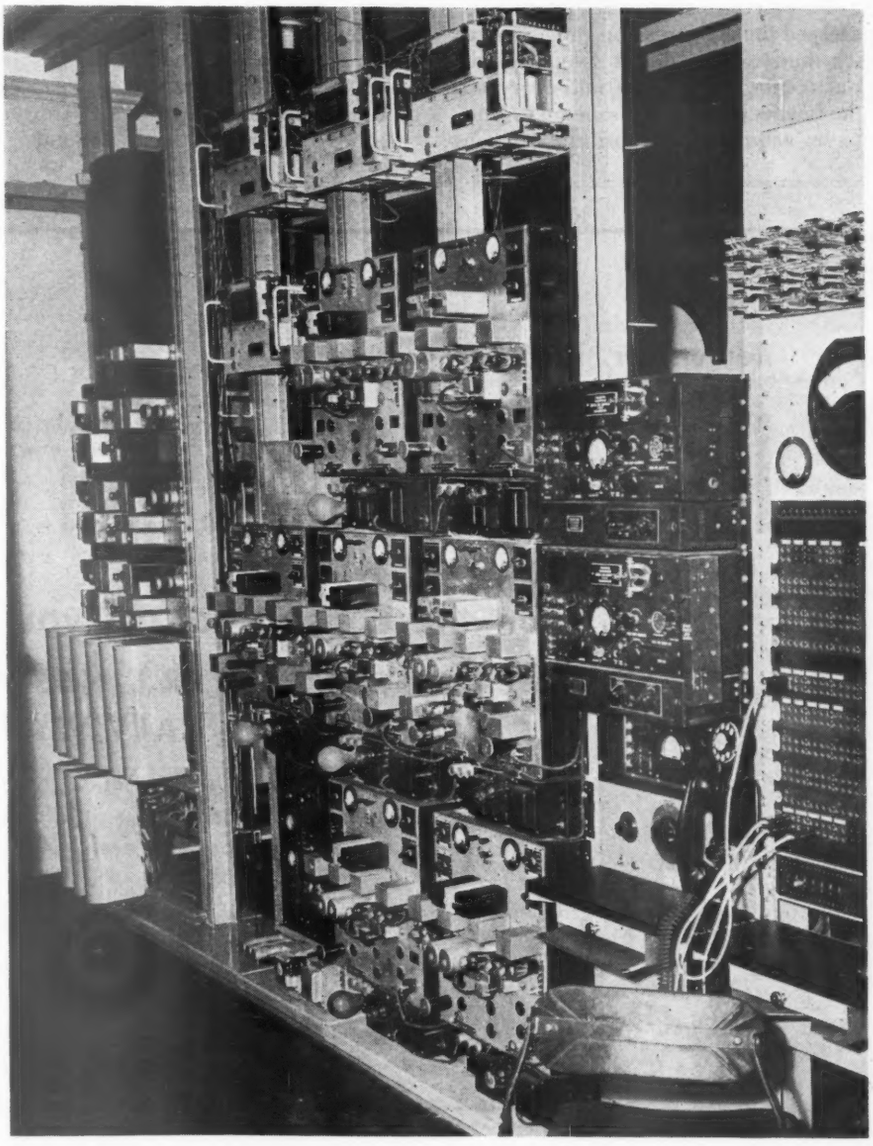
Progress Continues

We have progressed a great deal in our communication systems since those first pipe lines were built in California, but the end of this progress is not yet in sight. One of the more recent innovations is the use of point-to-point and mobile radio. Radio has great possibilities for the petroleum industry. Its uses are almost unlimited. At present, mobile telephones are being used to keep in close contact with key men, who cover considerable territory and spend much of their time in their automobiles. Mobile service is also proving valuable for contacting the drivers in the transportation and sales department truck fleets.

Radio and radar have been tried, and this service is proving advantageous in off-shore drilling operations. Facsimile transmission equipment is another comparatively new type of service that may be used quite extensively by the oil industry. It operates over a telephone line, either wire line or carrier circuit. By merely dropping a letter, print, or other document into the transmitting machine, which resembles a teletypewriter in size, the document is reproduced at the other end of the line. This service has an advantage over teletype in that it does not require specially trained operators, and as the name implies, a reasonable facsimile of any type of document is obtained at the receiving end, permitting the sending of much material that could not be handled by teletype.

The field of telemetering and other remote control equipment is perhaps one of the greatest economy-producing uses for which telephone circuits

Electronic telephone equipment of Shell Oil Company.



may be employed. This field has not been extensively exploited to date, except for control of standby pump stations and other minor plants. It is quite practical to control the entire operations of such a plant over a telephone circuit without interfering with the use of the circuit for telephone and telegraph purposes.

It is not difficult to visualize the future control of entire tank farms, gauging, pumping, or other such activities via spare telephone exchange circuits or special signal cables installed for this purpose. In fact, some installations of this nature are in progress at present. The equipment for this purpose is very similar to that now being used extensively by power companies for control of substations and other electrical plants.

The Telephone Department

The pipe line telephone systems are constructed, maintained, and operated by a small group of employes in each company, in most cases a subdepartment of the pipe line transportation division.

The electronic age has greatly increased the transmission range, capacity, and extent of our telephone departments, but it has not decreased the headaches of telephone men. They have acquired a multitude of new troubles. Vacuum tubes burn out or go flat, transformers, resistors, reactors, condensers, etc., etc., go open, go shorted or just go dead. Higher frequencies increase cross-talk and inductive interference. Coordination of parallel circuits must be far more accurate than in the past. In addition to new troubles acquired, the old ones are still with us. The birds and the bees still conspire to make the maintenance man's days miserable. He may find that a crow has built a nest on a crossarm right between his wires, using scraps of wire or pieces of welding rod for the framework. He opens a pole terminal only to find that a swarm of bees has taken possession, and a quick retreat follows. Unsuspectingly he picks up a broken line wire, not knowing that it was burned down by a falling power line, with which it is still in contact. The resulting shock causes him to lose his upper plate. He is called out by the pipe line dispatcher in the wee hours of the morning to shoot trouble on an important dispatching line. The trouble, when found, was probably due to a truck with raised "A" frame driving through the lead, a drunk driver hitting a pole, a boy shooting at insulators, or one of a thousand other causes. Wind, rain, sleet, snow, sandstorms, and earthquakes all help to make a trouble-shooter's life more interesting.

The trials and tribulations of pipe line telephone men would be unsurmountable were it not for the close cooperation between the telephone departments of the various oil companies. There is an unwritten rule among these men, when shooting line trouble on their circuits, to repair other oil company circuits as well. This cooperation works to the advantage of all concerned, especially in time of storms and disasters. This was demonstrated conclusively in 1943 when the circuits of several major companies were broken down along the Ridge Route for approximately 40 miles by a sleet storm. By combining forces, repairs to all circuits were made in a fraction of the time otherwise required.

In conclusion, I should like to hand a few orchids to the girls who operate the switchboards for this essential service. They must always know just who is who, and where to find him. They have stood by their posts rendering valuable assistance in the protection of life and property during blackouts, fires, storms, and earthquakes while many were thinking only of their own safety. Their motto seems to be, "The calls must go through."

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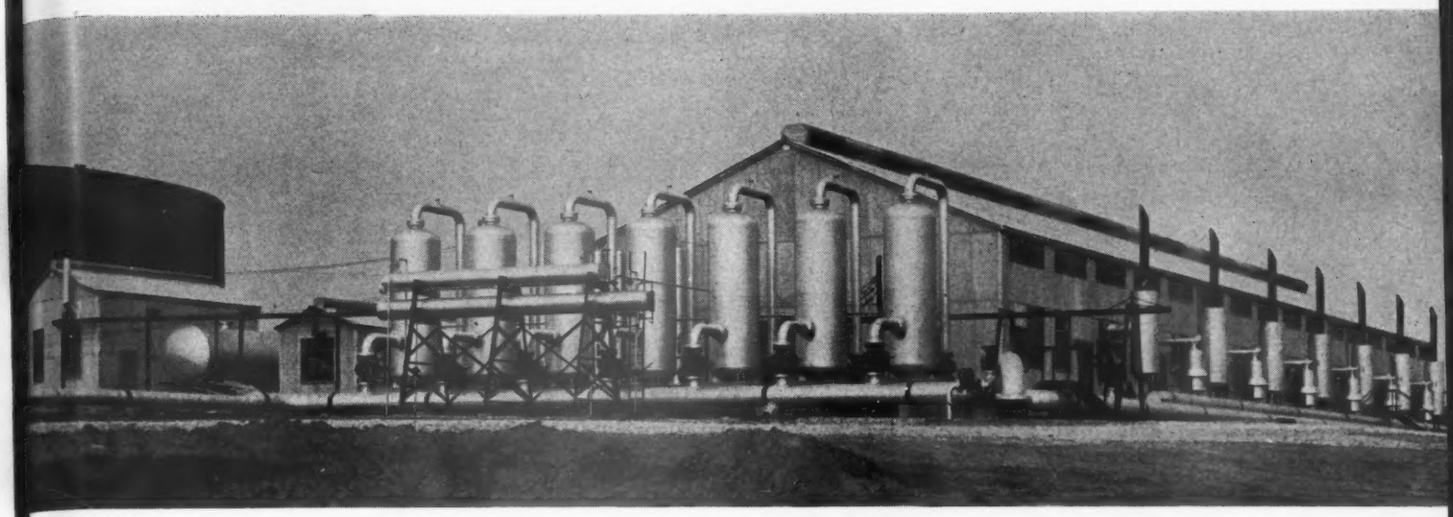

Exterior view of the station at Bald Knob, Arkansas.

What of the Inch Lines Today?

FRANK H. LOVE*

WHEN World War II was in its early phases and submarines were sinking far too many tankers carrying crude oil and motor fuels, the government stepped in to foster construction of an overland pipe line from producing areas in Texas to the eastern seaboard to facilitate vital fuels reaching military channels. This was known as the Big Inch pipe line. Soon afterward another pipe line was built by the government, a products line, extending from Beaumont, Texas, to the eastern seaboard, and because it was 4 in. in diameter smaller than the Big Inch, it became known as the Little Big Inch. Due to the nature of the emergency for which they were built, construction of these lines was attended by considerable fanfare and worldwide publicity. With the end of the war, however, came an end to the government's need for the lines and bids were asked for their purchase. Texas Eastern Transmission Corporation, a company organized especially for the purpose, was the successful bidder, and plans were begun immediately to convert the line to the transmission of natural gas.

*Pipe Line and Marine Transportation Editor.

Peacetime conversion of the two pipe lines from one usage to another did not provide the same glamour as did the original construction, which took place under stress of a world crisis, so, while not inferring that the project was without considerable publicity, it may be that there are phases of this operation not universally well known. It may not be amiss, then, to ask the question "What of the Inch Lines Today?" What had to be done before these two continuous steel arteries—one 1254 miles, the other 1479 miles long—could be used to move gas to the industrial consuming centers of the East, and what has been the performance record of the system in the less than two years that it has been operating under the changed setup?

When Texas Eastern assumed charge of the lines in May, 1947, they had been operated on a temporary basis over a period of several months by another gas transmission company. This operation was entirely at wellhead pressure, consequently, when taken over for total conversion, the capacity was only 140,000,000 cu ft a day. Under the program of construction instituted at that time, and which has continued uninterrupted to the present, installations have lately been completed that give the line a capacity of 508,000,000 cu ft a day. Company management is still looking ahead, however, and already has made application to the Federal Power Commission for permission to provide facilities that will boost the line's capacity to 740,000,000 cu ft a day. This request is pending.

EXCLUSIVE

The Problem

When the lines were taken over by the present operator, certain fixed conditions existed. The line had a definite origin and a definite terminus. Spacing of the stations was fixed, as was the diameter of the pipe. The wall thickness of the pipe and the valves and fittings already installed restricted the maximum operating pressure of the system. The area in which the gas could be marketed was determined and the source of supply as well. Fortunately, the Appalachian area, where the lines terminate, has numerous industries that use natural

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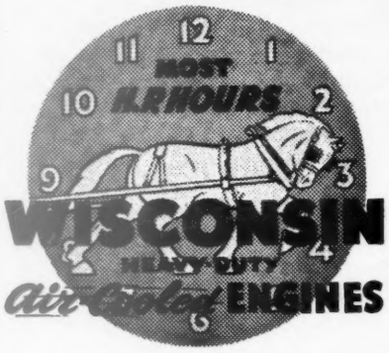

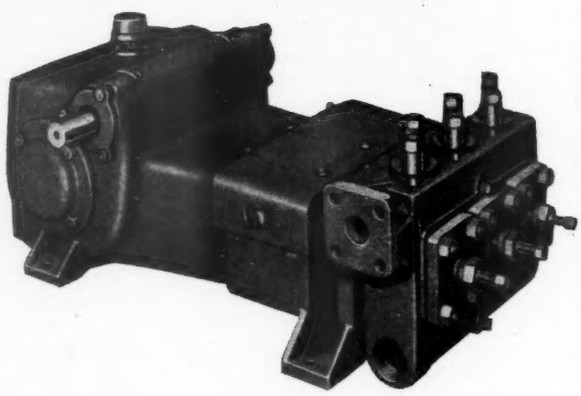

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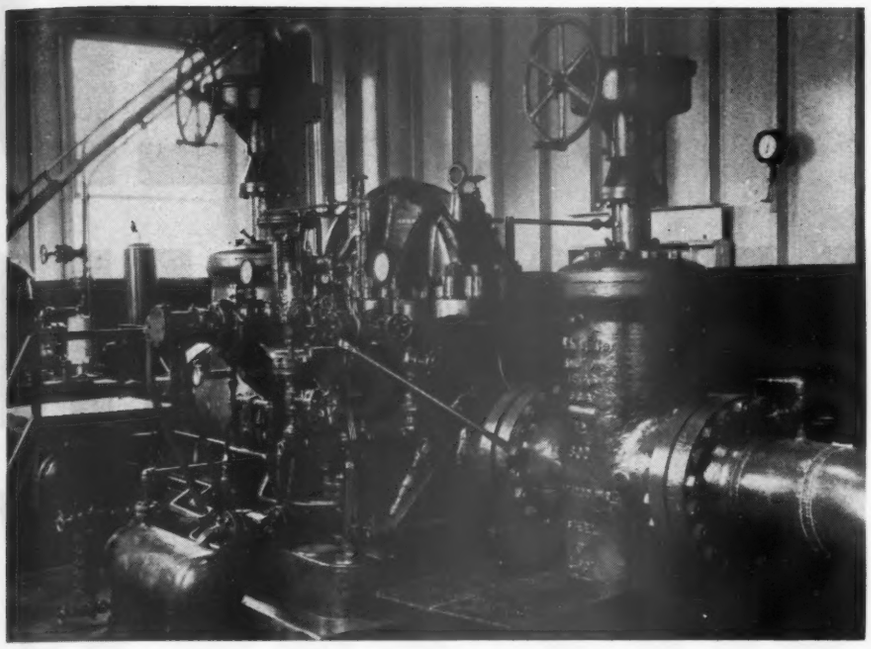

One of four centrifugal compressors installed at Atlanta, Texas.

gas as fuel. These industries are served by the distributing companies to which Texas Eastern makes deliveries. Fortunately, too, the route of the line was through or near a number of large gas producing fields that could be tied into the system with a minimum mileage of connecting lines. Thus the matter of supply and the market presented no major problems.

Another consideration was the stipulation by the government at time of sale that for matters of national security the oil transportation facilities must be maintained in standby condition so that at any time during a period of 20 years they could be reconverted to the pumping of oil and products within 90 days, for operation by the government during periods of emergency. This meant that it would be beneficial to make as few changes as possible in station setup and that as much of the existing equipment as possible be used. This was a consideration that affected vitally the type of compressors that were installed.

Compressor Selection

Centrifugal compressors were selected for many of the stations, although they had never before been used for such high pressures nor for cross-country transmission of natural gas. By using this type of compressor it was possible to utilize many of the motors that were employed as prime movers during operation of the lines for crude oil and products. Further, the compressors were specially built so they could be mounted on the same foundations that had been used for the oil pumps and with no change in piping. Oil pumps were simply removed and the compressors installed. Should a national emergency arise, the change can be made back to the pumping of oil just as readily.

Another consideration was the fact that the electrical system that was already installed at all stations could be utilized with minimum changes if centrifugal compressors with electrical drive were adopted.

The electrically driven centrifugal compressor, however, lacks the feature of variable capacity, speed or compression. This is an important consideration, so to correct this inability to meet changing flow conditions, seven reciprocating stations were installed out of a total of 21 stations on the system.

At the stations where centrifugal compressors were installed the old station buildings are used for the most part, although in some instances extensions were required. At reciprocating stations, however, entirely new station buildings were erected and the original equipment left in its former housing.

The centrifugal compressors are direct connected through a firewall to 3600-rpm, squirrel cage induction motors of horsepower ratings from 1250-2000. Reciprocating compressors consist of 1000 and 1100-hp units.

Construction Program

To increase the line's capacity from 140,000,000 cu ft a day to its present 508,000,000 cu ft, 21 stations were built, 14 with motor-driven centrifugal compressors and 7 with reciprocating compressors of the gas engine vertical type. Total reciprocating horsepower installed to date amounts to 73,900, and centrifugal compressor horsepower to 166,000 making an overall total of 239,900.

The accompanying table presents data showing location of stations, type of compressors installed, horsepower, and operating pressures.

Under the converted setup no pumping equipment is required at Station No. 1 (Longview, Texas) on the Big Inch, nor at Stations A, B, C, D, (Baytown, Beaumont, Newton, Texas and Many, Louisiana) on the Little Big Inch. Gas is delivered to Station F (El Dorado Arkansas) and Station 2 (Atlanta, Texas) under well pressure. The two lines occupy a common right-of-way from Little Rock to the terminus and pumping stations are operated in parallel.

In addition to the compressor sta-

Station data on Texas Eastern Transmission Corporation System.

Station No.	Location	Type of Compressors	Horsepower	Suction pressure psi	Discharge pressure psi
F	El Dorado, Ark.	Reciprocating	4400	573	750
G	Fordyce, Ark.	Centrifugal	7500	484	750
2	Atlanta, Tex.	Centrifugal	8000	610	800
3	Hope, Ark.	Reciprocating	8300	563	800
4	Donaldson, Ark.	Centrifugal	8000	562	800
5	Little Rock, Ark.	Centrifugal	15,500	461–555	750
6	Bald Knob, Ark.	Reciprocating	15,400	488	750
7	Egypt, Ark.	Centrifugal	17,250	493	750
8	Fagus, Mo.	Centrifugal	13,500	506	750
9	Oran, Mo.	Reciprocating	14,000	499	750
10	Lick Creek, Ill.	Centrifugal	12,000	554	750
11	Norris City, Ill.	Reciprocating	13,000	509	750
12	Princeton, Ind.	Centrifugal	15,000	494	750
13	French Lick, Ind.	Reciprocating	10,000	571	750
14	Seymour, Ind.	Centrifugal	17,500	486	750
15	Batesville, Ind.	Centrifugal	9000	578	750
16	Lebanon, Ohio	Centrifugal	14,250	515	750
17	Circleville, Ohio	Centrifugal	12,500	520	750
18	Crooksville, Ohio	Reciprocating	8800	575	750
19	Sarahsville, Ohio	Centrifugal	6000	580	630
20	Wind Ridge, Pa.	Centrifugal	10,000	470	700
			239,900		

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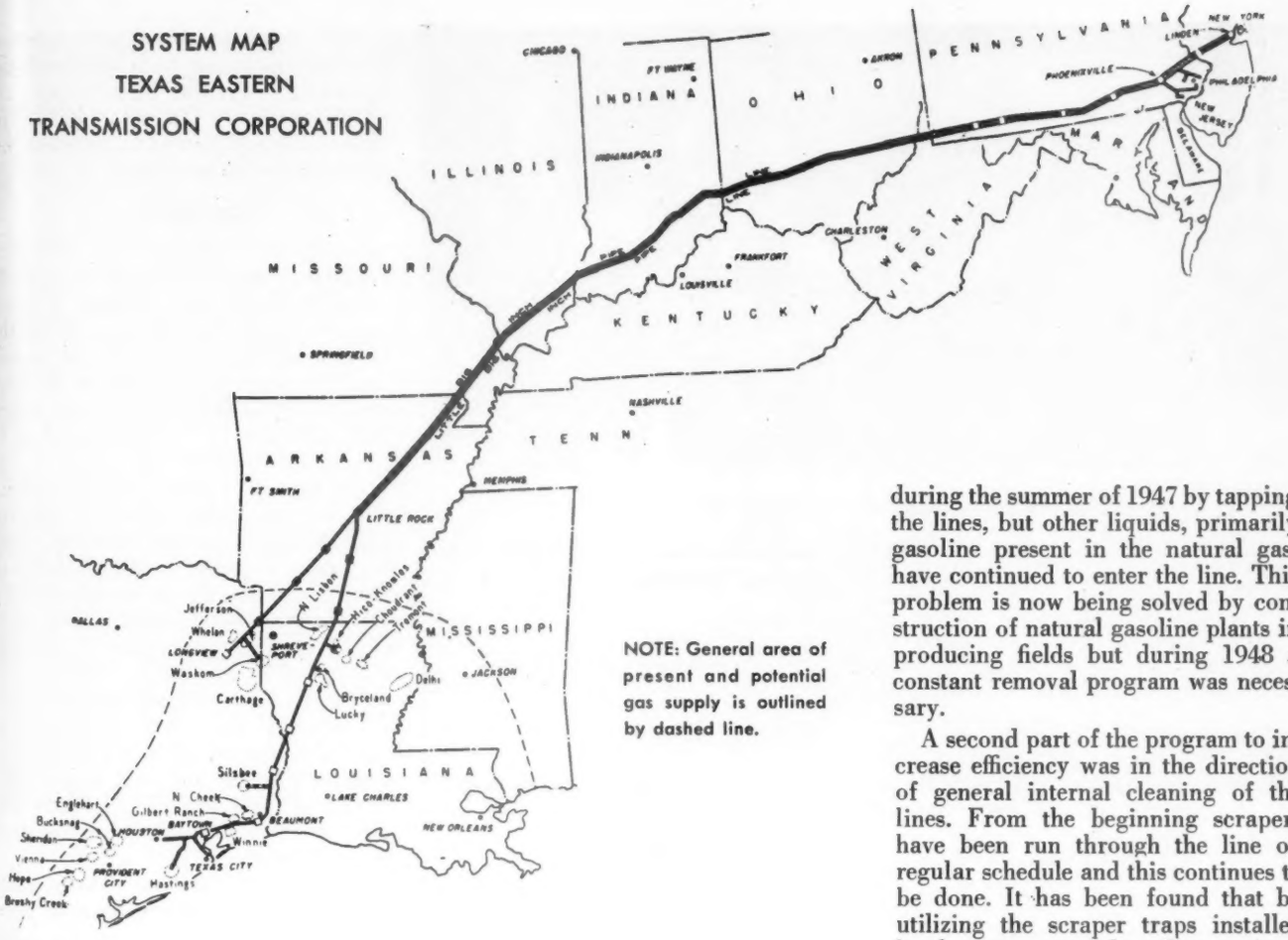


NOTE: General area of present and potential gas supply is outlined by dashed line.

tion construction program, several new lines were laid to tie-in gas supply not immediately adjacent to the main lines and to make deliveries to new customers. In the Houston area, 18 miles of 8-in. was laid to reach gas production in the Hastings field. The Waskom field was tied in at Jefferson by 30 miles of 8, 10, and 12-in. The Hico Knowles field was connected by laying 17 miles of 12 and 14-in. line, and the Bryceland field was tied in with 1½ miles of 7-in. Silsbee field gas was reached with 17 miles of 10-in.

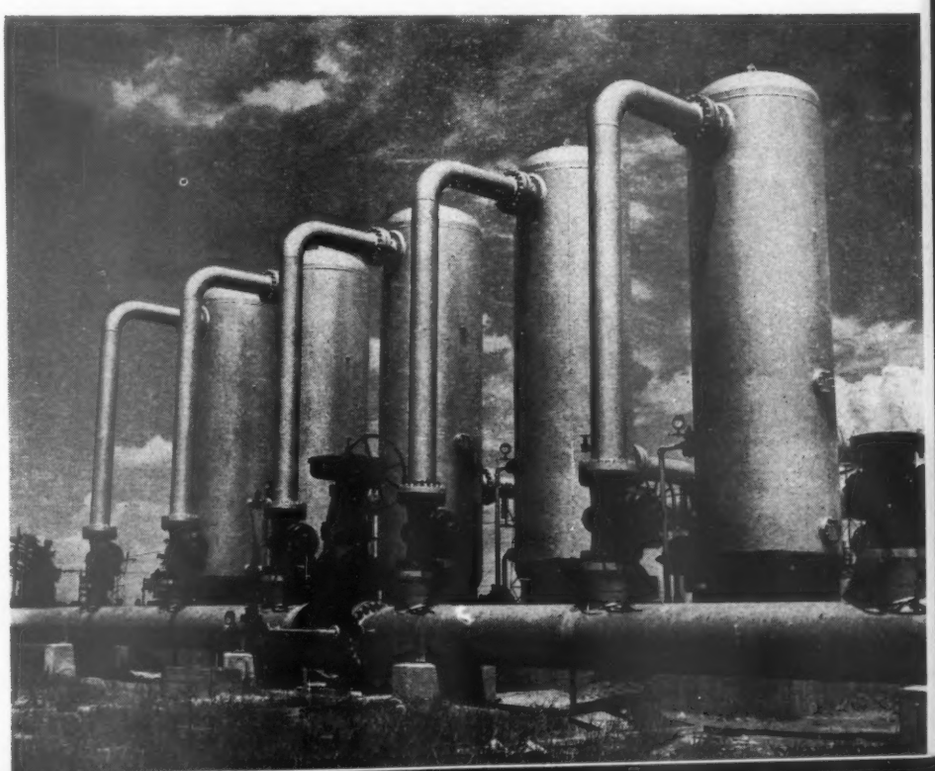
As a matter of insurance river crossings were looped.

The largest of the lines laid for sales distribution was in the Philadelphia area, where 20 miles of 12-in., 6 miles of 8-in., and 1 mile of 6-in. were installed.

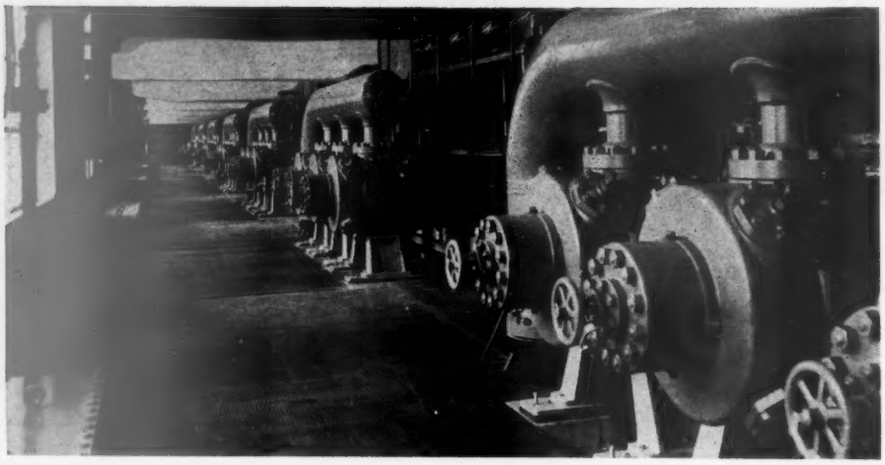
Raising Efficiency

One of the principal problems since the line was taken over has been to raise efficiency of the pipelines to operating peak. This problem has been fairly well solved now, but when Texas Eastern took charge of the system the efficiency was only 67 per cent. A major factor in the low efficiency at the outset was the presence of water that had been left in the lines after it had been used to remove oil and products. This water was removed during the summer of 1947 by tapping the lines, but other liquids, primarily gasoline present in the natural gas, have continued to enter the line. This problem is now being solved by construction of natural gasoline plants in producing fields but during 1948 a constant removal program was necessary.

A second part of the program to increase efficiency was in the direction of general internal cleaning of the lines. From the beginning scrapers have been run through the line on regular schedule and this continues to be done. It has been found that by utilizing the scraper traps installed by the government for oil operations, the scrapers could be moved through the lines under gas pressure and without the necessity of cutting the line for their removal along with dust, dirt, and scale, as has been customary practice on gas pipe lines. Such procedure lessens the time and work entailed and also eliminates the loss of considerable gas that attended the former procedure, at the same time normal flow of gas is not interrupted.

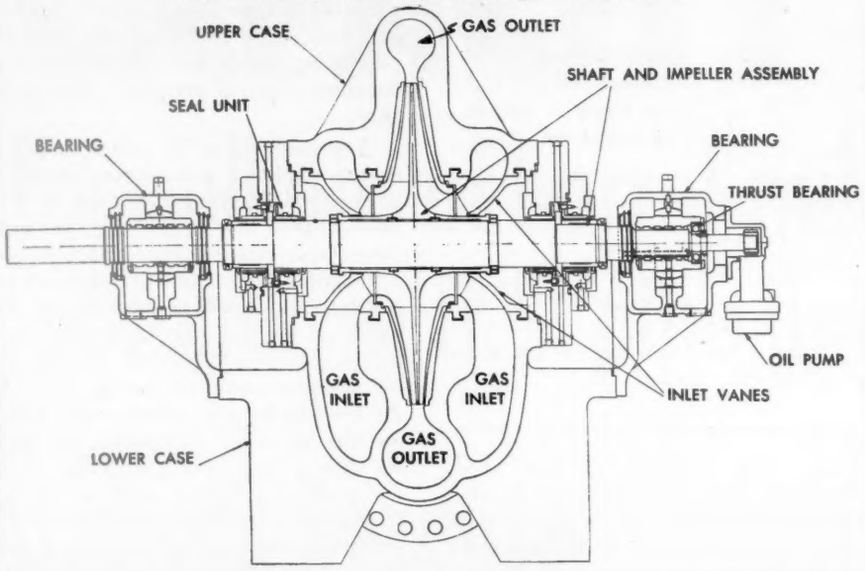


Gas scrubbers at the Little Rock, Arkansas, compressor station.



Interior of the compressor station at Norris City, Illinois.

The cross-section of the centrifugal compressor.



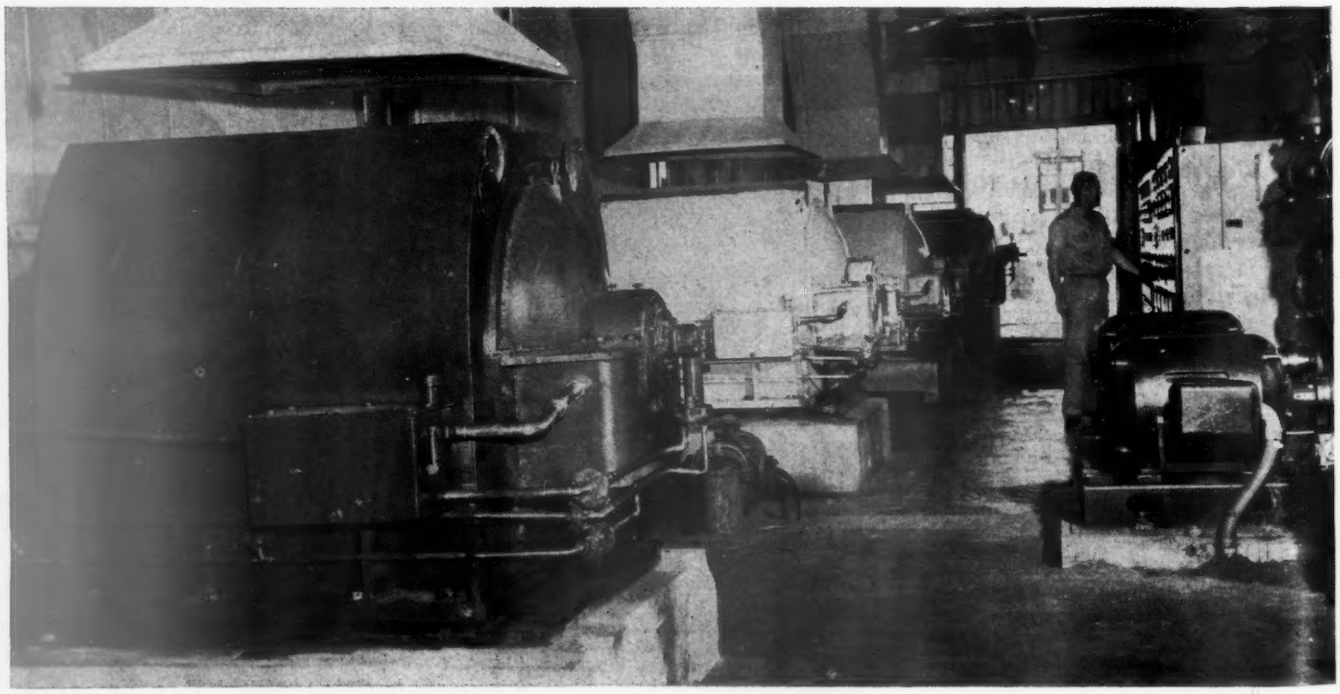
This liquid removal and internal cleaning program had increased the efficiency of the line from 67 per cent to 89 per cent by the end of 1948. The immediate aim now is to increase this efficiency to 92 per cent.

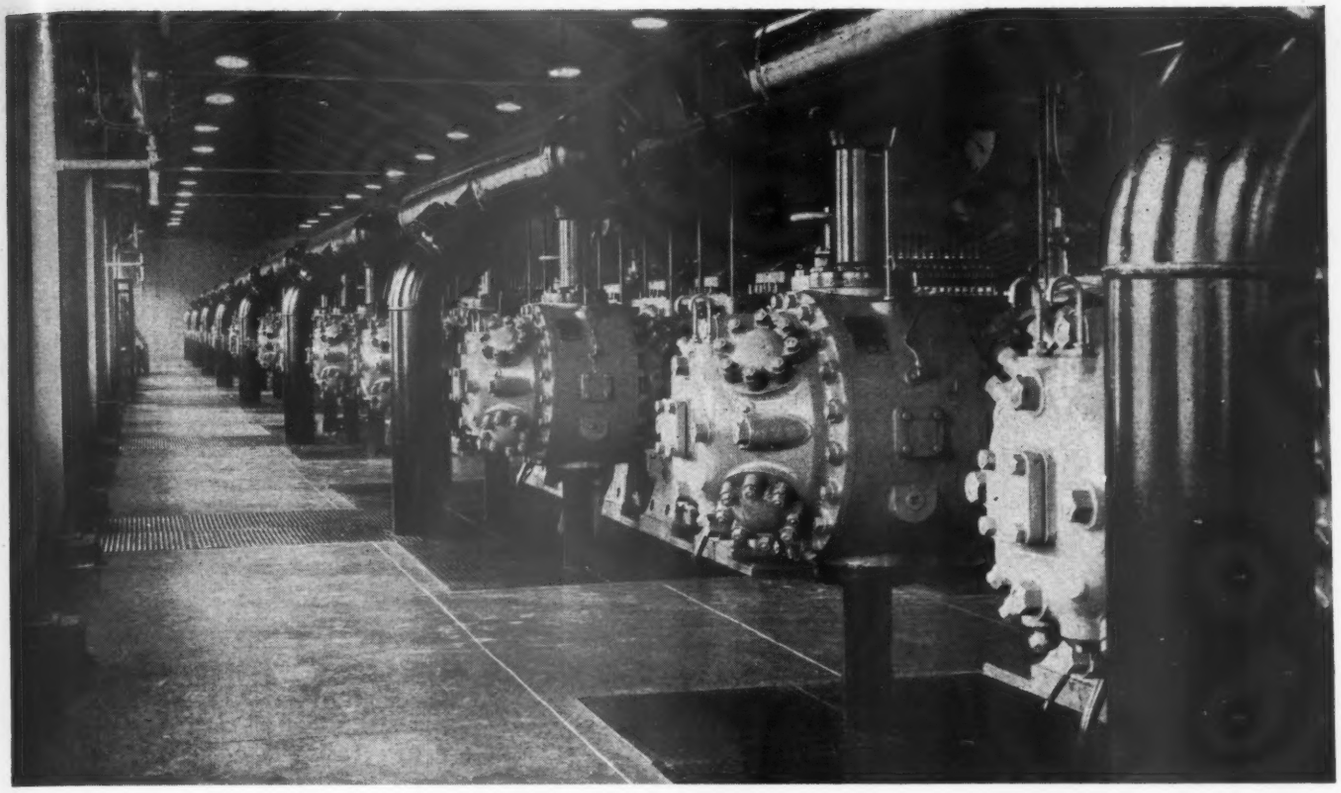
Operations

Centrifugal Compressors. The centrifugal compressor is not a complicated machine and contains a minimum of parts, as can be seen in the accompanying cross-sectional drawing. The most important single part is the shaft sealing unit. On the original units this is a mechnical seal of the hydraulic type and consists of three primary parts: Rotating ring and two stationary sleeves that provide the surface contact for the rotating ring. Proper contact of these sleeves with the ring is maintained by oil pressure that is greater than that of the gas being compressed. The oil also provides a cooling medium for the seals. Each compressor unit has its own seal oil system and standby units also are provided. On the earlier installations the oil seal units were placed at floor level beside the compressors; now they are being installed beneath the floor.

Electrical Equipment. Texas Eastern is among the largest users of electrical power in the country. To drive its prime movers and other equipment more than a billion kilowatt hours of

Motor side of the 24-in. line compressor building at Little Rock. D. E. Harper is at the control board.





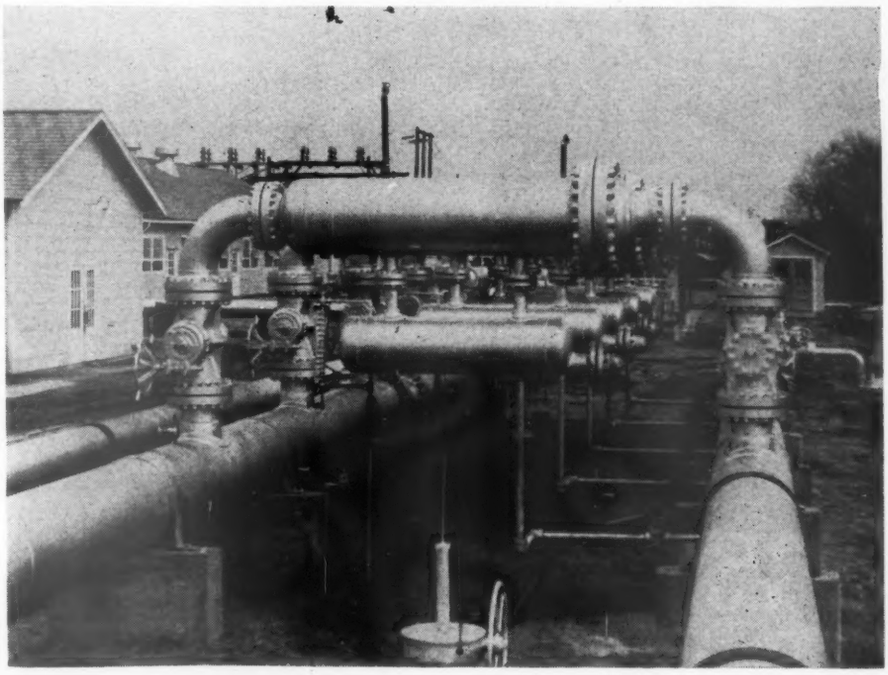
The Hope, Arkansas, station contains eight reciprocating compressor units, five of 1000 hp and three of 1100 hp.

power is used each year. This figure is more impressive when it is considered that a billion kilowatt hours is more electrical power than is produced in the entire United States in a single day.

The electrical system, being one of the principal facilities at the original stations, has been utilized as completely as possible. In fact, the availability of these facilities was an important factor in the decision to use centrifugal compressors with motor drive. Consequently, all motors of the proper rated speed are in service. At the reciprocating stations, the 1750-rpm motors that could not be used to drive centrifugal compressors are housed and maintained in operating condition in event the system should again be needed to pump oil.

Scrubbers. As protection for the compression equipment scrubbers were installed in all stations. The first units were of the conventional liquid type. A dry type scrubber, however, has been installed at 10 of the centrifugal stations and is shown in one of the accompanying photographs. The principle of the dry type scrubber is new insofar as its application to gas scrubbing is concerned, although it has been used previously in other industries to clean air. The scrubbers, which were manufactured especially for this system, consist of tubes inside a shell housing. The gas passes through the tubes in a whirling motion and the flow is reversed before the gas enters the suction headers. Drop in pressure across the scrubber, which is less than 2 psi at rated conditions, results in the dropping out of any liquid not already removed by the centrifugal action.

Communications. Inasmuch as there are no facilities for storing gas between the source of supply and delivery points, dispatching is an integrated, continuous process, making readily-available communications essential. The company, therefore, has



Something new in scrubbers—a dry type unit made especially for installation at some of the stations.

leased full-time telephone circuits connecting its general offices in Shreveport, Louisiana, with all division offices and compressor stations. Pressure reports and routine information are received over these facilities. Additionally, FM radio communication has been installed on many of the company's automotive units and additional radio installations are contemplated.

Line Patrol. Constant vigilance is kept for possible line leaks, which might result in considerable loss of gas or the creation of a hazardous condition. Airplanes are used for patrolling the lines and a contract covering this patrol provides for a weekly flight over the lines in small, low-speed planes at altitudes of 500 ft or less. When a potential emergency is observed a report is radioed or telegraphed to the operating crews.

Future Program

Texas Eastern now has an application before the Federal Power Commission for permission to provide still further facilities, which will increase the system's capacity to 740,000,000 cu ft a day.

During 1948 arrangements were made with Texas Gas Transmission Corporation whereby that company would be delivered quantities of gas up to 200,000,000 cu ft a day. This gas would be delivered at a point near Lisbon, Louisiana. In turn, Texas Eastern would receive gas from Texas Gas Transmission at a point near Middleton, Ohio, in quantities up to 235,000,000 cu ft a day. Of this amount, 210,000,000 cu ft would be delivered to The East Ohio Gas Company, Manufacturers Light and Heat Company, and The Ohio Fuel Gas Company at delivery points on Texas Eastern's system in Ohio, West Virginia, and Pennsylvania.

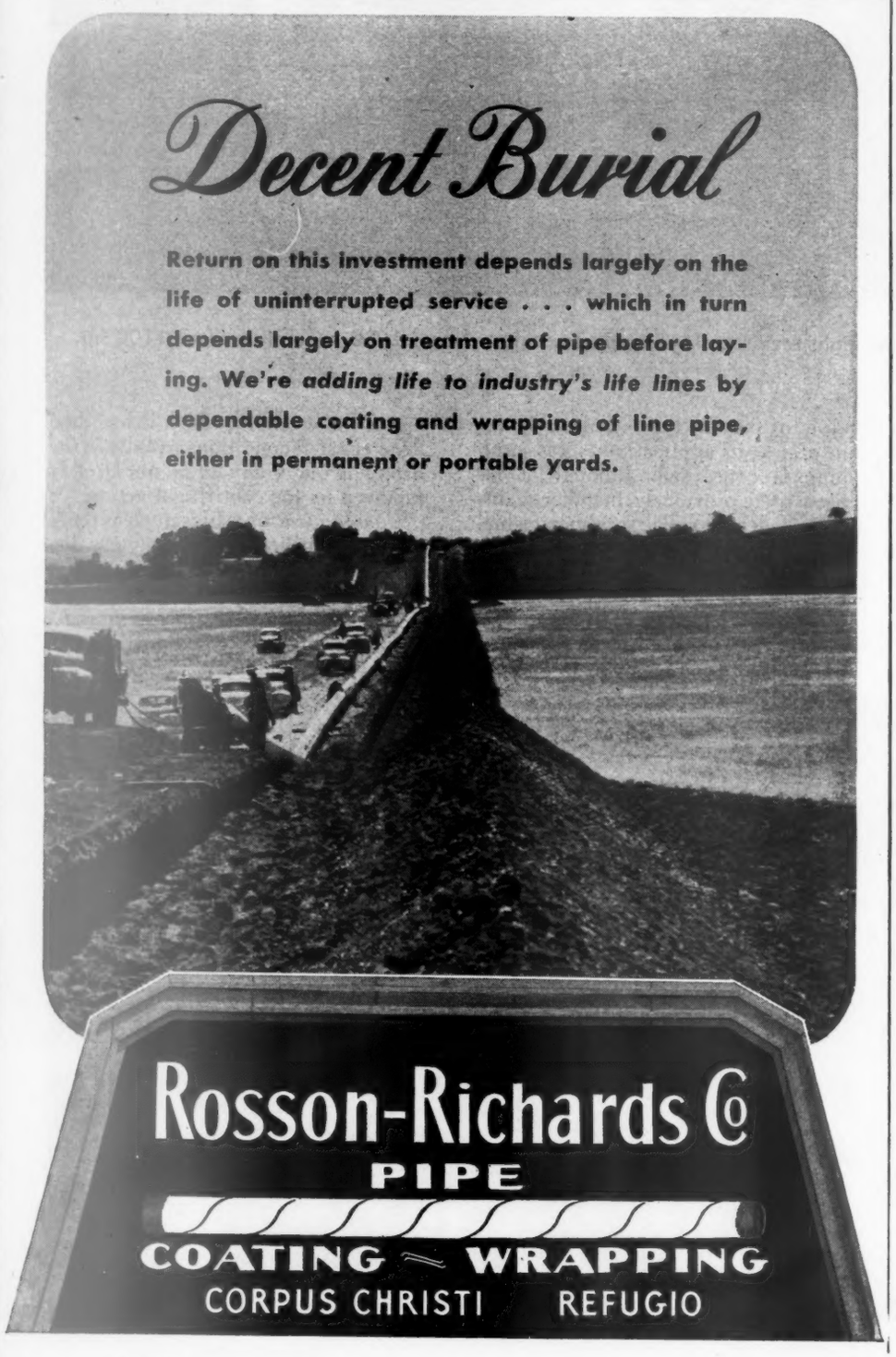
To make this program possible, 115 miles of 16-in. line would be laid from Baytown into Lavaca County, Texas, to reach new sources of supply. The Little Big Inch line would be looped south of Lisbon, Louisiana, with approximately 70 miles of 20-in., and both main lines would be looped from Middleton, Ohio, north of Cincinnati, to a point near Wind Ridge, Pennsylvania, a distance of about 179 miles. This would be of 26-in. pipe. A total of 32,750 compressor hp also would be added to the system. New stations would be built at Beaumont, Texas, Newton, Texas, Many, Louisiana, Caster, Louisiana and Lebanon, Ohio. The stations at Beaumont, Caster, and Lebanon would have reciprocating compressors and those at Newton and Many centrifugal compressors. Changes would be made at four other stations in order to handle the additional volume. These are the Circleville, Crooksville, and Sarahsville, Ohio, and the Wind Ridge, Pennsylvania, stations. Such work would consist of changing wheels on centrifugal compressors, changing size of reciprocating compressor cylinders, installation of additional scrubbers, and providing what yard piping is required.

In another application filed with FPC, the company has requested a certificate to lay a third line paralleling the present two lines. This would be of 26-in. pipe and would extend from Longview, Texas, to a point near Wind Ridge, Pennsylvania, with laterals to various supply points from Longview. The capacity of the line would be 425,000,000 cu ft a day.

Upon completion of this work the system's compressor horsepower would be increased 272,650, consisting of 184,250 centrifugal hp, and 88,400 reciprocating hp.

Contractor

The contracting firm in charge of station construction was Brown and Root, Inc., Houston, Texas. * * *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PIONEERS IN STEEL PIPE PROTECTION

Checking Gas Engine Performance With Manifold Vacuum Gage

ALVA C. SMITH*

FOR several years there has been a demand from high speed gas engine operators for a rapid and reliable method of checking engine operation. Obviously, not all gaugers, pumpers, operating engineers, and others required to operate high speed gas engines are "experts" on gas engines. In recognition of this need, we have equipped our gas engines with a vacuum gage.

The vacuum gage is mounted on the instrument panel and is connected to the intake manifold with copper tubing. It should always be placed in such a position so that it can be read at a glance. It is suggested that it be mounted on a common center line with other instruments on the panel when possible.

The main purpose of the vacuum gage is to determine the load on the engine. Additionally, the vacuum gage is one of the most useful instruments known for checking engine performance or operation. The ability to use the gage correctly and intelligently interpret its reading will enable the engine operator to determine the following: (1) per cent of load on the engine under all conditions of operation; (2) faulty engine operation at a glance; (3) whether engine has been properly selected and installed; (4) whether the V-belt drive has been properly calculated; (5) whether the pumps' liners are of the right size to meet pressure conditions; (6) whether the suction lines are adequate and the discharge lines are of the proper size; (7) presence of bad spark plugs; (8) presence of a burned exhaust valve; (9) a defective carburetor; (10) a defective magneto in some instances; (11) worn pump liners or "slippage," and (12) hot bearings, which by binding the shaft may be creating additional load on the engine. In general, it may be said any change in the condition of the engine that tends to make the engine operate inefficiently will be shown by a *drop in the vacuum*, and any abnormal operating condition that tends to decrease the load will be shown by a *rise in the vacuum*.

The vacuum gage is not a new development, nor a complicated instrument requiring special skill or a technical education to correctly read and intelligently interpret its readings. All good mechanics have come to recognize this instrument as one of the most useful tools in their kit. The mechanic who has not fully recognized the value of the vacuum gage has failed to exercise the patience required to use the gage correctly and interpret its readings in a practicable manner.

To become familiar with the operation of the vacuum gage, it is a good plan for the engine operator to make a few simple tests on an engine known to be in good condition, and observe the reaction of the vacuum gage while these tests are being made. It is suggested the engine be run until it reaches a normal temperature, then set the carburetor throttle to give an idling speed slightly higher than normal, and observe the vacuum gage. If the engine is in first class condition with the head and manifold tight, and if the ignition, carburetion and mechanical parts are functioning normally, the vacuum needle will remain steady, somewhere between 17 and 21 in. At this point the operator should pull the throttle wide open and allow the engine to attain full speed for a few seconds, then quickly close the throttle while observing the vacuum gage. The needle should drop to approximately 2 in. and then rebound to 25 in. or more, if the piston rings, cylinder walls, and oil are in good condition. (See Fig. B).

If the piston rings, pistons, or cylinder walls are worn, or the oil is too thin, the vacuum will be lower than normal when the idling test is being made. When the throttle valve is opened and closed quickly, the needle of the gage will drop to zero on opening, but will not rebound to 25 in. when closing. (See Fig. C).

On completion of the above described test, put the engine on the load and observe the vacuum gage. If the engine is not overloaded, the needle will indicate a reading somewhere between 5 and 21 in., depending upon the per cent of load. This test is known as the "Load Test."

Determination of the load on an engine is the most important application of the vacuum gage. If the engine has been properly selected and installed, if the V-belt drive has been properly calculated, if the pump liners are of the right size to meet the pressure conditions, and if the suction lines are adequate and the discharge lines of the proper size, then operation of the unit at rated speed will result in a vacuum gage reading from 7 to 8 in. This represents an ideal load on an engine.

If, however, the load is greater than planned or the engine is in bad mechanical condition or in need of adjustment, then the vacuum may be 6 in., 5 in., or even 4 in. This would be considered an unsatisfactory load condition and we cannot expect the engine to give satisfactory service at 5 in. or less. Simply stated, a vacuum of 5 in. or less indicates "overload" and the gauger or engineer should report this condition immediately. On the other hand, if the vacuum is 9 in. or higher the engine is not loaded heavily enough, and the gauger or engineer should call for larger pump liners if the pressure rating of the pump, line pressure, and capacity conditions will permit the change.

These statements assume that the entire unit is in first class mechanical condition; however, this is not always the case. Without a regular program of inspection and preventive maintenance the best machinery can be expected to give trouble with use. For example, assume we have an engine that has been operating steadily against a given line pressure with 8 in. of vacuum. Then with the line pressure unchanged and the pump apparently normal the vacuum drops to, say, 6 in. The change indicates something has gone wrong with the engine. It may be a burned exhaust valve, a bad spark plug, burned ignition points, loose valve guides, a bad manifold leak, a blown cylinder gasket, sticky valves, or a defective carburetor. Any change in the condition of the engine that tends to make the engine operate inefficiently, that is "lose power," will be shown by a drop in the vacuum.

A condition opposite to that discussed above may arise. For example,

*Superintendent of Mechanical Maintenance, Mid-Continent Pipe Line Company.

EXCLUSIVE

we may have an engine that has been operating steadily against a given line pressure with 8 in. of vacuum. Then, with the line pressure unchanged, the vacuum may rise to 10 in. This change in the operating conditions will not likely be the result of increased engine efficiency, but is likely to be the result of decreased pump capacity. It may be caused by bad valves, rings, liners, etc. The engine operator alone will be responsible for learning the relation between the vacuum gage reading and the line pressure, so that he may be able to interpret his readings in relation to the pump or engine as the case may be.

Generally, it can be stated that an engine in first class condition mechanically, operating under average conditions, will develop approximately 25 per cent of full load at 15 in. of vacuum; 50 per cent of full load at 12 in. of vacuum; 75 per cent of full load at 8 in. of vacuum, and overload begins at 5 in. of vacuum. Engines that have been in continuous service for long periods without repairs may indicate different readings, inasmuch as the engine will not develop the same horsepower as it developed when in A-1 condition. The reading should be correspondingly lower. For this reason it should be generally understood that the vacuum gage does not measure the horsepower developed by an engine; however, it will definitely indicate the per cent or degree of full load on the engine.

To illustrate, assume we operate a 300-hp and a 100-hp engine at a common location, both of which are operating under 75 per cent of full load. The vacuum gage reading on both engines would be approximately 8 in., whereas the engines would be developing 225 and 75 hp, respectively.

It should be remembered that the maximum horsepower output of any engine will vary with different fuels, temperatures, etc.; however, the vacuum gage eliminates the necessity of considering these various conditions, inasmuch as it will give an almost perfect indication of the percentage of load that the engine is carrying under any condition.

Indication of faulty engine or pump operation is a secondary but important application of the vacuum gage. Some of the tests for engine condition have of necessity been discussed in preceding paragraphs and will not be repeated. A thorough understanding of the following discussion will assist the operator in anticipating engine trouble and enable him to give the machinist a good idea of the nature of the "trouble" before he arrives to make repairs. Reporting trouble in this manner will greatly assist the machinist in determining in advance the repair parts he is most likely to need to make the required repairs. Cooperation of this kind often may eliminate return trips for repair parts, and the consequent delay in getting the pump "on the line" again.

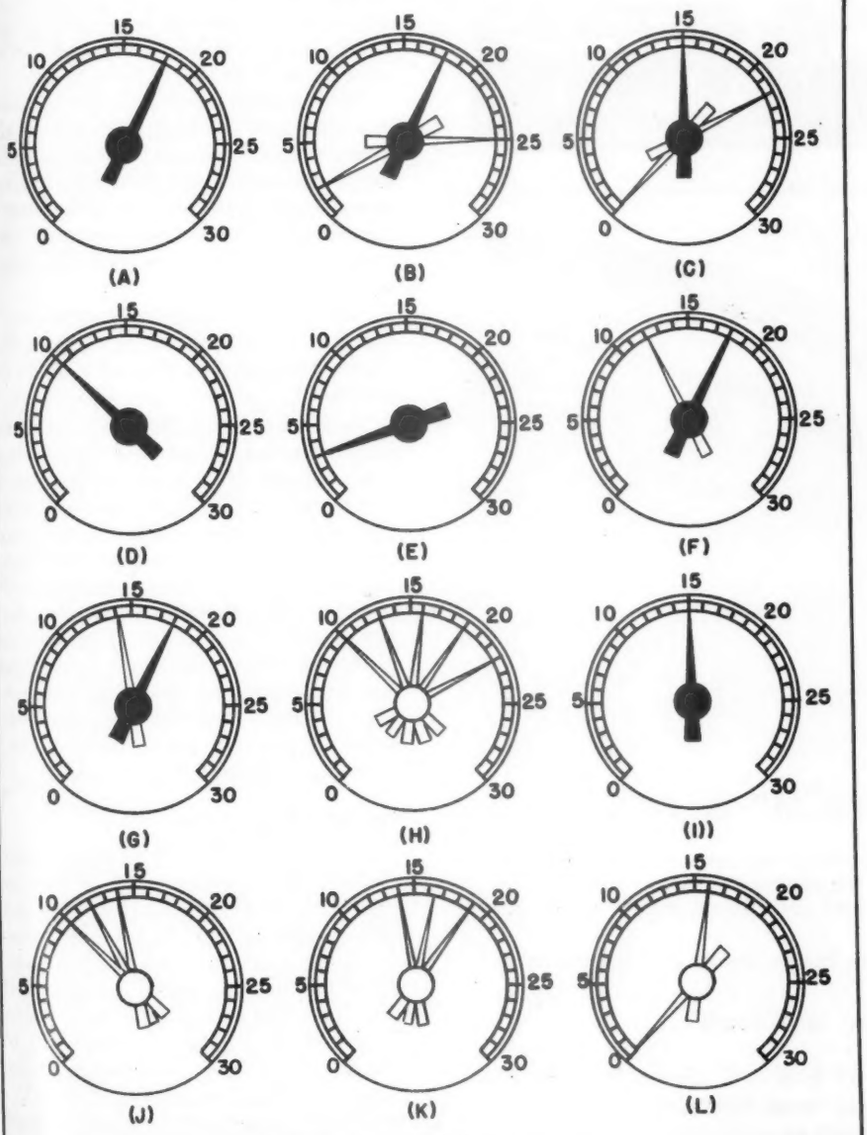
The following mechanical defects are indicated by the vacuum gage in a manner described as follows:

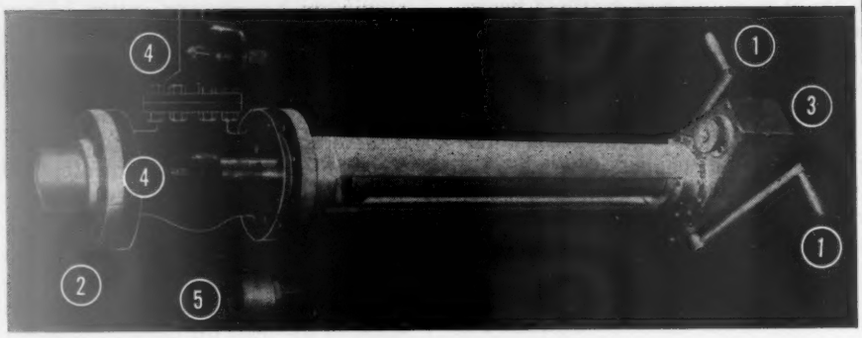
(1). Loose valve guides will produce a low reading on the vacuum gage, with very little movement of the needle, (see Figs. D and E), because of the fact air is constantly being drawn through the guide and partially destroying the vacuum in the intake manifold. This condition will be accompanied by loss of power and greater oil consumption.

(2). A bad manifold leak also will cause a low gage reading, (see Figs. D and E) and, if this condition is suspected the gauger should seal the intake manifold gaskets with some heavy oil or grease. If the reading then becomes higher, the leak is in the gasket; if it remains low, the valve guides are worn.

(3). A leaky valve will not seal adequately the compression in the cylinder, and every time the valve is on its seat, which occurs at equal intervals, the needle will drop several inches (see Fig. F). The amount of drop depends on the extent to which the valve remains open. A blown cylinder head gasket produces a similar effect on the vacuum gage, but the operator or mechanic can determine whether the trouble is in the valve by introducing a small quantity of oil into the intake manifold and observing the vacuum gage. The same effect can be produced by increasing the output of the top oiler. If the trouble is in the valve the engine will speed up temporarily and hold the vacuum

FIGS. A TO L





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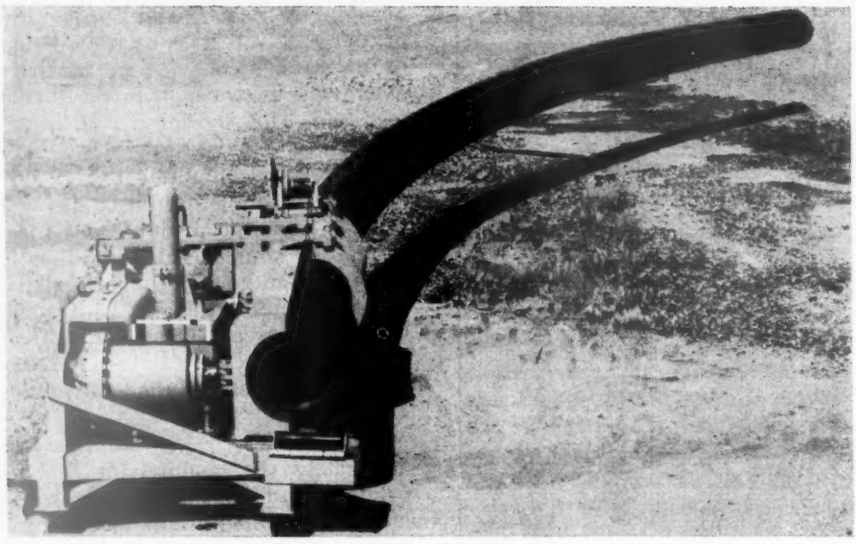

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steady; whereas no such effect will be noticed if the head gasket is blown or defective.

(4). Sticky valves are indicated when the needle of the gage drops four or five points at regular intervals. (See Fig. G). The same reading on the gage might also indicate a mixture that is too rich or too lean, an occasional spark plug miss, or internal carburetor trouble.

(5). When the gage needle fluctuates over a wide range, as shown in Fig. H, and increases with higher engine speeds, weak or broken valve springs are indicated.

(6). Improper timing of the engine is indicated by a low reading and the needle may swing backward and forward. (See Figs. I and J.)

(7). Late valve timing will also cause a low vacuum reading, with possibly a slow swinging back and forth of the vacuum needle. (See Fig. J.) This results from the charge being forced back through the intake valve during the compression stroke.

(8). An incorrect idling mixture is generally indicated when the gage needle swings slowly back and forth. (See Figs. G and K.)

(9). A mixture that is too rich or too lean will burn slower, the result being that the combustion will sometimes continue until the intake valve opens, causing the vacuum to be interrupted. Also, too lean a mixture can cause an irregular drop of the gage needle.

(10). When the gage shows a normal reading at the start, but the needle drops gradually, a choked muffler is indicated.

Such abnormal engine operating conditions may be created by shorting out a spark plug with an insulated screw driver. The operator will note that when the plug is shorted the governor rod will move to open the throttle, and the vacuum gage reading will fail. Secondly, the muffler may be partially choked and the drop in vacuum observed. Other abnormal conditions can be created by changing the timing, inserting a feeler gage between valve tappet and valve, or changing the carburetor adjustments, etc.

* * *

To Sell Pipe Line

Atlas Oil and Refining Corporation, Shreveport, Louisiana, has offered its pipe line and refining facilities for sale, according to V. B. Chance, president. The company owns and operates 82 miles of 8-in. and 6-in. crude oil pipe lines that extend from its refinery in the western edge of Shreveport to Minden, Louisiana, and thence to the Magnolia field, Arkansas. Sohio Petroleum Company owns 85 per cent of the corporation's stock.

NEWS

New Water Terminal

A new water terminal and fuel oil storage plant will be erected by Modern Heat and Fuel Company, 4415 Chestnut Street, on the east bank of the Schuylkill River at Peltz Street, near 29th Street and Grays Ferry Avenue, Philadelphia, announced Harry D. Marks, president. It will be the first plant of its kind to be built in Philadelphia since the war, and when completed will be the largest independent plant on the river, according to Marks, embodying the latest advances in design and construction for speedy handling.

Work on the new plant, which will have storage capacity in excess of 2,000,000 gal will begin immediately, Marks said. It was designed by Roy M. Henwood Associates, New York, nationally known architects who specialize in this field.

Makes Its 75,000th Power Control Unit

The 75,000th LeTourneau power control unit came off the production line recently at the Peoria plant of R. G. LeTourneau, Inc., manufacturer of earthmoving and construction equipment. This cable control unit actuates earthmoving tools towed by or mounted on tractors.

On hand to view the 75,000th unit as it left the assembly line were Roy E. McCluskey, vice president and general sales manager; Merle R. Yontz, vice president and treasurer, and Harold Jeter, manufacturing manager.

Guiding the unit through its final stages of manufacture, assembly and test were three men who helped produce the 100th power control unit, each of the trio joining the company shortly after the Peoria plant was opened in 1935. All were in the power control unit section when No. 10,000 was produced in 1941, No. 25,000 in 1942, No. 30,000 in 1943, and No. 50,000 in 1944.

Rate Hearing Postponed

The Federal Power Commission has postponed to April 4 the hearing previously scheduled to begin March 1, in the proceeding involving the investigation initiated by the commission of rates charged by United Natural Gas Company for sale of natural gas subject to FPC jurisdiction. Counsel for the company and the FPC staff requested the postponement.

United Natural, which has main offices in Oil City, Pennsylvania, owns and operates a gas transmission system in Pennsylvania and Ohio.

2203 Miles of Gas Line Authorized in Half Year

Natural gas transmission facilities designed to increase the capacity of the nation's pipe line systems by more than 600,000,000 cu ft a day and involving more than 2000 miles of new pipe line were authorized by the Federal Power Commission during the six-month period between July 1 and December 31, 1948, it is announced by Chairman Nelson Lee Smith.

Total estimated construction cost of these facilities was $191,382,265, of which $139,749,872 was for major projects estimated to cost $700,000 or more. The larger projects are expected to benefit 32 cities of 50,000 population or over in 12 states and the District of Columbia as well as numerous smaller communities. The construction of these major projects will increase capacities of the systems involved by at least 580,100,000 cu ft daily.

Largest single authorization during the six-month period was for El Paso Natural Gas Company to construct approximately 720 miles of pipe line, which would add 180,000,000 cu ft of daily delivery capacity to the company's system. Other large projects include Tennessee Gas Transmission Company's authorization to construct 515 miles of pipe, which would increase daily capacity of its system by 111,000,000 cu ft daily, and the Southern California Gas Company and Southern Counties Gas Company of California 103-mile project, to add 100,000,000 cu ft a day to the capacity of the companies' systems.

The projects covered by certificates of public convenience and necessity issued by FPC during the semi-annual period involve construction of 2203 miles of pipe line and installation of compressor units aggregating 150,304 hp. Larger projects costing $700,000 or more account for 1788 miles of line and 141,570 hp in compressor units.

Corrosion Study Made of Pipe Line Holddowns

Of interest to pipe line corrosion engineers is a recent investigation and laboratory analysis of corrosive action on the buried portion of rod assembly of The Grip-Tite Manufacturing Company's anchors, which are originally designed for the anchoring of derricks, masts, etc. In recent years this assembly, in larger model, has been much used for permanent holddowns of all kinds on pipe line construction, being particularly adapted to the marshy or swamp land of the Gulf Coast.

Rods from assemblies from separate wells used for guying derricks in the Manvel field, Brazoria County, Texas, were removed and enlarged photographic studies made of corrosive action on each. The anchor assemblies had been in service for more than 10 years. Rods were ¾ in. by 14 ft long. The rods were sandblasted and enlarged studies of No. 1 revealed considerable corrosion near the lower end. This extended but a short way up the rod. The remainder showed much less corrosion, and since the strength of the rod is determined by the strength at the bottom of the threads, it was noted that corosion had not reached this area. Study of rods for the second well revealed that the soil was wet almost the entire length of the rod. This rod had been in service more than 10 years. Although enlarged studies revealed corrosion, it was less severe than on the first rod examined. Though almost all galvanizing was gone the rod would have been good for a great many more years of service according to examining engineers. It was noted that the soil in this area has very low electrical resistance, being about 800 ohms per cu cm.

As this examination was of but two rods in the same general vicinity and did not include corrosion embrittlement tests that were made later, it cannot be assumed that these rods would show similar results in widely scattered areas, and it is possible that corrosion losses could be much greater in low lands and swampy lands.

Further investigation of similar rods used by utility companies in the Gulf Coast area revealed varied experience. In many locations the rods are still in use after 30 years' or more service. In this service a rod failure is evident at once. Failures were found in rod installations entering water strata, at or near the water line. Hence utility company anchors are being used with copperweld rod, which, though it does not eliminate failure, prolongs life.

In summarizing the utility of such anchors as pipe line anchors in low lands the investigator stated:

"Any doubt as to the length of life of these rods can be very easily and economically removed. For purchasers who wish this doubt removed it is suggested that the rods and anchors not be galvanized. In order to eliminate surface rust the rods must then be prime coated at the plant with the primer produced by the same manufacturer that is supplying the enamel with which the pipe line will be coated. Then when the anchor assemblies arrive on the field site, they will be

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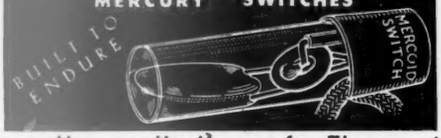

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given a new coat of similar primer and dipped in a bath of hot enamel, which will be made available to the contractor by the enamel supplier. In this manner the rods will be protected against corrosion as is the main pipe line. Or it may be found more practical to have the assemblies coated at the plant with a more durable coating than the above. In either case the application is rather simple and inexpensive. The saddle that rests on the pipe would be coated in the same manner.

When the complete assembly is installed on the line it is a simple matter to connect it with the pipe line so that it also may receive cathodic protection if this protection is applied to the line. All chances of loss of the anchors by corrosion would then be removed. In view of the value of such pipe line and the loss of service that could occur it does not seem far fetched to go to all of this effort to insure that the anchors will not fail. The operator would not know it if these anchors had failed until it was too late."

This investigation was made by Starr Thayer, consulting engineer, for Grip-Tite Manufacturing Company.

Hyster Distributor Named

New distributor of Hyster lift trucks, straddle trucks, and mobile cranes in the vicinity of Baltimore, Maryland, is the McCall-Boykin Company, Inc., at Calvert and 20th Streets in Baltimore, according to an announcement from C. H. Collier, Jr., head of eastern division truck sales for the Hyster Company.

Headed by W. S. Boykin, president, and John M. McCall, vice president, the company will handle Hyster sales and service in all of Maryland except Washington, Allegany and Garrett counties; in Kent and Sussex counties of Delaware; in Accomac and Northampton counties of Virginia, and in the District of Columbia.

Smith-Blair Expands

Smith-Blair, Inc., South San Francisco, California, manufacturers of pipe line supplies and specialties has completed a factory addition that more than doubles plant capacity. According to Telford Smith, president, these new manufacturing facilities make it possible to absorb last year's 40 per cent increase in business and still maintain the company policy of prompt shipment on either standard or special orders. Three additional acres of industrial land were purchased last year in anticipation of further growth based on new product developments and refinements, as well as improved stock and service facilities throughout the country.

FPC Amends Rules On Application Filing

The Federal Power Commission has adopted three amendments to its "General Rules and Regulations" that will have the effect of simplifying and clarifying the procedures followed by the commission with respect to minor or temporary changes in the operating facilities of natural gas companies. The amendments are effective immediately.

The first of the new rules, by defining the term "facilities" as used in Section 7(c) of the Natural Gas Act, makes it possible for natural gas companies to construct certain types of minor changes in existing systems without the necessity of seeking a certificate of public convenience and necessity from the commission. Types of construction covered by the new rule include auxiliary installations that are installed for the purpose of obtaining more efficient or more economical operation of authorized transmission facilities; replacement facilities that do not appreciably change the daily delivery capacity of an existing pipe line system, and metering and regulating installations and branch lines necessary for the establishment of new delivery points required for the delivery of gas to existing customers for resale in a local community presently served from the same pipe line system.

Under the second rule, issuance of temporary certificates of public convenience and necessity is limited to cases where applications for permanent certificates are pending and the temporary authorization involves only such minor extensions and interconnections as may be necessary to assure maintenance of adequate service or to serve particular customers.

The third rule exempts from the certificate requirements of the Act temporary construction and operation of facilities necessary to assure maintenance of adequate service during emergencies such as failure of equipment or supplies. This temporary operation is limited, however, to a period of not more than 60 days, and all facilities constructed from such an emergency must be removed after discontinuance of use unless appropriate application subsequently is made for a certificate. Companies engaged in temporary operations are required to file notice with FPC within ten days after commencement with a statement explaining the purpose of the operations. In addition, a notice f a discontinuance must be filed within ten days following the end of operations, and a notice of removal of facilities is also required within ten days.

Pipe Line Marine Transportation Personals

▸ **Max B. Ederington,** former district superintendent of Interstate Oil Pipe Line Company's northwest district, has been made assistant manager of the Andian National Corporation, Ltd., Colombia, South America. Ederington has been serving as general superintendent of the Colombian company since early last year.

G. E. "Bud" Mays, engineer in the Staff Engineering Department of Interstate, Tulsa, Oklahoma, has assumed new duties in the New York office of **W. R. Finney,** pipe line adviser for Standard Oil Company (New Jersey).

Oma R. Bates, formerly with the Southern Division Property Tax Department of the Interstate, has assumed new duties in Tulsa as public relations assistant in the office of **P. H. Hunter,** secretary.

▸ **L. J. Meyer,** senior engineer for the Texas Railroad Commission, Oil and Gas Division, has resigned to join the Houston staff of Trans-Continental Gas Pipe Line Corporation.

▸ **Edward F. Fisher** has been elected president of Gar Wood Industries, Inc., Wayne, Michigan. Fisher comes to Gar Wood Industries after four years of retirement following a highly successful career in the automotive industry. The Fisher brothers, it will be recalled, founded Fisher Body, which is now a Division of the General Motors Corporation.

Fisher will head an organization made up of four divisions in Wayne, Michigan; Findlay, Ohio; Minneapolis, Minnesota, and Richmond, California.

▸ **D. F. Cooledge,** district gauger at Denver City for Shell Pipe Line Corporation has been promoted to district chief gauger in the Wheeler-TXL field of West Texas. **F. W. Payne,** who has been district chief gauger at Wheeler-TXL has been transferred to McCamey, Texas.

▸ **Bert Mahanay** and **John B. Hall** have been made station engineers at the Kadane, Texas, station of Stanolind Pipe Line Company.

Walter Fletcher, division machinist at Carrollton, Missouri, for Stanolind, has been retired. He joined the organization, then the Sinclair-Cudahy Pipe Line Company, in February, 1918.

▸ **Earl M. Converse,** a vice president since 1934, has been appointed senior vice president and **Eugene P. Fager** was elected vice president and industrial department manager of Dearborn Chemical Company at the 61st annual stockholders' meeting. The appointment of Converse was made in recognition of 46 years of service with the company. In 1947 the American Society of Metals awarded him the Silver Certificate for twenty-five years of meritorious service and contributions to the Society.

Fager joined Dearborn's laboratory staff in 1920, becoming a director of the company in 1934. In 1941 he was elected assistant vice president and technical director.

▸ **Francis Coryell,** chief research engineer for the Interstate Oil Pipe Line Company, delivered a paper on "Aluminum Pipe in Crude Oil Service" before the February 21 meeting of The Pipe Liners Club of Tulsa, held in the Mayo Hotel.

▸ **Raymond H. Crowe,** Stanolind Pipe Line Company employe 16 years, has resigned to accept a position with Stone and Webster Service Corporation of New York City. Crowe will head an engineering staff that will certify construction by Fish Engineering Corporation, Houston, Texas, of the Trans-Continental Gas Pipe Line Company's $190,000,000 line from South Texas to New York City.

Crowe's staff will have head quarters in Houston, McGraw said. At the present time pipe is being shipped to locations along the line route, and actual construction of the line and compressor stations is scheduled to begin in April. Fish engineering has the contract for the complete planning, designing, engineering, and construction of transmission line and other facilities, including compressor stations and dehydration plants.

▸ **Harry Conyers** has been advanced from welder-mechanic to assistant superintendent of the Bushton, Kansas, compressor station of Northern Natural Gas Company. **R. B. Patterson,** maintenance mechanic at Sublette, Kansas, has been made assistant superintendent of that station. **Lester Innis** has been promoted to assistant superintendent at the Mullinville, Kansas, station. He has been a maintenance mechanic.

E. O. Martinson *E. W. Maas* *E. A. Brugger*

▸ **E. A. Brugger** was named vice president in charge of production for the Koehring Company of Milwaukee, Wisconsin, manufacturer of heavy-duty construction equipment. A veteran of 32 years service with Koehring, Brugger for the past 10 years, had been general manager of the Parsons Company, a subsidiary located in Newton, Iowa.

E. O. Martinson has been transfered to Koehring from the C. S. Johnson Company of Champaign, Illinois, another subsidiary, where he was general manager. He is assuming the duties of chief engineer. Martinson spent several years on the Grand Coulee Dam project and the TVA.

E. W. Maas, a 31-year Koehring veteran and works manager since 1946, was named vice president and general manager of the Kwik-Mix Company, a subsidiary located in Port Washington, Wisconsin.

In naming Brugger and Martinson to positions at the parent Koehring Company, President **C. E. Long** stated that Vice President **R. A. Beckwith** would devote his full time to engineering development work at Koehring and its three subsidiary companies. In addition, he said, Vice President **F. H. Heine** will serve as director of foreign operations and utility officer. Beckwith has been chief engineer since 1940 and Heine was named works manager in 1939 and production manager in 1946.

▸ **The Pipe Liners Club** of Tulsa, Oklahoma, has announced the following recent new members:

Jack L. Byrd, engineer, Interstate Oil Pipe Line Company, Tulsa.

J. L. Burke, president, Stanolind Pipe Line Company, Tulsa.

Robert L. Bullock, corrosion engineer, Interstate Oil Pipe Line Company, Tulsa.

Fred B. Crandall, mechanical engineer, Phillips Petroleum Company, Pipe Line Department, Bartlesville.

W. F. Davis, assistant to general superintendent, Northern Division, Interstate Oil Pipe Line Company.

Hubert L. Drake, Sr., engineer, Stanolind Pipe Line Company, Tulsa.

Edward A. Fuller, mechanical engineer, Gulf Refining Company, Tulsa Pipe Line Division, Tulsa.

N. F. Gambel, assistant superintendent, Pure Oil and Pure Transportation Company, Tulsa.

Maynard H. Jackson, sales engineer, Standard Pipeprotection, Inc., Tulsa.

Oliver C. Klinger, president, *The Pipe Line News*, Bayonne, New Jersey.

Q. L. Pickle, senior engineer, The Texas Pipe Line Company, Tulsa.

Joe C. Rawlins, chief engineer, Interstate Oil Pipe Line Company, Tulsa.

David A. Roach, engineer, Phillips Petroleum Company, Products Pipe Line Department, Bartlesville.

J. C. Stirling, supervisor authorization, Stanolind Pipe Line Company.

Alva C. Smith, superintendent mechanical department, Mid-Continent Pipe Line Company, Tulsa.

Dean B. Taylor, engineer, Phillips Petroleum Company, Products Pipe Line Department, Barlesville.

Frank Wheatley, Jr., executive vice president, Frank Wheatley Pump and Valve Manufacturer, Tulsa.

T. D. Williamson, Jr., vice president, T. D. Williamson, Inc., Tulsa.

A. C. Wilkinson, vice president and manager, Continental Pipe Line Company, Ponca City.

Milton E. Worlow, engineer, Phillips Petroleum Company, Products Pipe Line Department, Bartlesville.

Chas. G. Wrigley, instrument engineer, Stanolind Pipe Line Company.

C. C. Yarrington, engineer, Stanolind Pipe Line Company, Tulsa.

R. E. Young, manager, operations, Pure Transportation Company, Tulsa.

J. B. Zachry, sales engineer, Worthington Pump and Machine Corporation, Tulsa.

▸ **Hugh W. Baird** has been appointed vice president of Standard Pipeprotection, Inc., St. Louis, Missouri. Baird is widely known in the pipe line industry, having first-hand experience in the production, sales, protection, and installation of pipe.

Hugh W. Baird

Standard Pipeprotection, Inc., is a company recently organized to coat and wrap pipe up to 12½ in. diam. using new application techniques.

▸ **Pete Darigo,** assistant engineer at Kansas City for Panhandle Eastern Pipe Line Company, has been transferred to Liberal, Kansas.

Expanded Facilities for An Expanding Industrial Area . . .

Houston Pipe Line Company has expanded its system of natural gas pipe lines to enlarge the service it renders to the expanding industry of the Texas Gulf Coast. Now the system supplies natural gas to Texas homes and industries from the Big Thicket to the Nueces. In 1949, the company is better equipped than ever before to render this essential service to Texas industry. The construction and recent completion of approximately 100 miles of main pipe lines to its gas fields in East Texas have increased its ability to keep pace with the expanding economy of the Texas Gulf Coast.

This year, the Houston Pipe Line Company is in its fourteenth consecutive year of *national advertising* of the Texas Coast Country's industrial opportunities, in *Fortune Magazine,* chemical and textile trade publications, and other national magazines. Through this advertising and the detailed information which the company offers, new industries have been given assistance in the location of their plants on Texas' fabulous coast. But the company's chief contribution to Texas' industrial expansion has been to supply it with *natural gas,* industry's most efficient and economical fuel, and raw material for many of the processes in the Coast Country's great chemical development.

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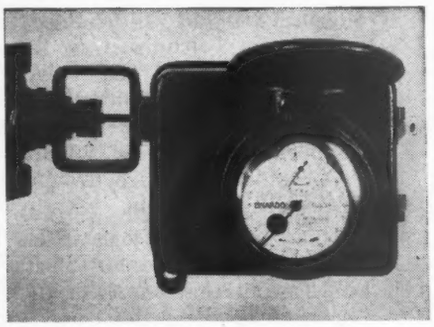
The ENARDO Time Cycle Switch

The clock actuated mercury tube Enardo Time Cycle switch will pay for itself within a few weeks by convenience, return trip mileage and operator's time. This time-saving switch is designed to open or close any type of electrical circuit. It has proven itself a real money-saver on remotely located pumping units and pipe line engines.



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★ Weather proof
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The ENARDO Automatic Shut-Off Valve

The features unique in the Enardo shut-off valve are two independent actions—(1) The main spring is used only for driving the timing mechanism, thus assuring accuracy. (2) A separate spring trips the valve control lever. Very satisfactory for controlling low pressure liquid and gas lines.

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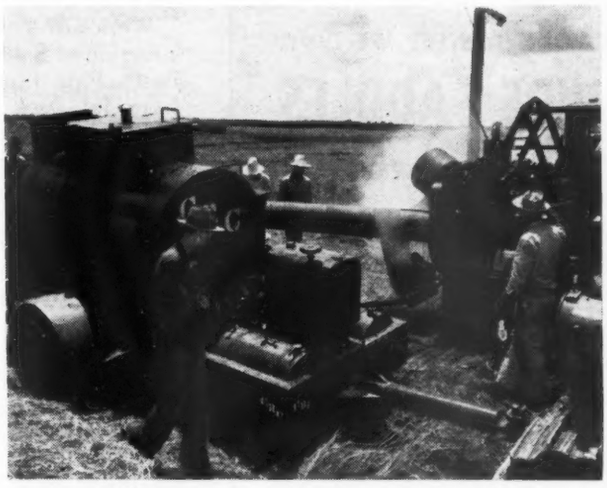

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With the PIPE LINE CONTRACTORS

▸ **A. C. Holder Construction Company,** Tulsa, Oklahoma, is making progress on the 382-mile, 10-in. crude oil line being laid for Atlantic Pipe Line Company from the West Texas Permian Basin to the lower Gulf Coast of Texas. Specifically, the line will extend from Block 31 in Crane County to a point near Refugio. At the latter point the new line will tie-in with Atlantic's existing system for movement of oil to the company's water terminal at Harbor Island near Aransas City. In West Texas the line will be connected to the company's existing system, which terminates at Midland. A. C. Holder is in charge for the contractor.

▸ **Midwestern Constructors, Inc.,** Tulsa, Oklahoma, had completed a third of Section No. 1 on the Ozark Pipe Line System of Shell Pipe Line Corporation by February 24. Progress was delayed on this job five weeks because of blizzards. Section No. 1 consists of 79.5 miles of 22-in. from Chelsea, Oklahoma, to Cushing, Oklahoma. M. T. (Bill) Wilhite is superintendent in charge. The field office is at Cleveland, Oklahoma; telephone: 705.

Due to bad weather the kickoff was delayed on the "Reading Spur" for Socony-Vacuum Oil Company, Inc. Construction actually began February 10 on this 22 miles of 6-in. The field office is at Douglasville, Pennsylvania. Lyle S. DeWitt is superintendent in charge.

▸ **Latex Construction Company,** Houston, Texas, announces that work is just getting under way (February 26) on the laying of 40 miles of 6-in. and 8-in. pipe for The California Company near Ruston, Louisiana. The field office is at Ruston and F. A. Silar is in charge of the job.

Work began March 10 on 10 miles of 4-in. for T. R. Bryan Associates near Opelousas, Louisiana. J. A. Cantrell is in charge and the field office is at Opelousas.

Near Bay City, Texas, 15 miles of 4-in. is being laid for the Dow Chemical Company. This work began March 15. E. C. Norris is in charge.

Work also began March 15 on construction of four pump stations on the Basin Pipe Line Company's system from Jal, New Mexico, to Cushing, Oklahoma. The stations will be at Lindsay, Oklahoma; Haskell, Texas; Colorado City, Texas, and Odessa, Texas. Lindsay and Haskell stations are being constructed first. J. B. Latham is in charge for the contractor.

▸ **Dunn Brothers,** Dallas, Texas, stringing contractors, have completed about 35 per cent of their work (March 3) on the El Paso Natural Gas Company job. The contractor is stringing 95 miles of 24-in. pipe from Kermit, Texas, toward the Upton County station. The field office is at Kermit with L. L. Rowland superintendent.

The 70 miles of 20-in. pipe for Lone Star Gas Company between Opelika and Dallas, Texas, is 80 per cent strung. Clifton Hammett is superintendent. The field office is at Terrell.

The El Paso Natural job is being laid by that company's construction crews, the Lone Star job by Eastern Construction Company.

▸ **Anderson Brothers Corporation,** Houston, Texas, has been awarded a contract by the Buckeye Pipe Line Company for construction of 82 miles of 22-in. pipe from Lima to Toledo, Ohio. Work is expected to begin about the middle of April. The new line will parallel Buckeye's existing line from Lima to a point south of Toledo. Crude oil will be delivered to refineries at Toledo of Gulf Refining Company, Sun Oil Company, Pure Oil Company, and Standard Oil Company. About half of the pipe already has been coated by the Somastic Division of H. C. Price Company of Bartlesville, Oklahoma.

This contractor also is laying 201 miles of 22-in. line for Shell Pipe Line Corporation on its Ozark Pipe Line System. The section extends from Roxdale station to Wood River, Illinois. The Missouri and Mississippi rivers are being crossed with dual lines, and the Gasconade River with a single line. The contractor has his central field office at St. Charles, Missouri, and is working three spreads.

▸ **Eastern Construction Company,** Dallas, Texas, had laid approximately 40 miles of the Lone Star Gas Company's Opelika-Dallas 20-in. line by March 3. Construction of 30 miles remains. This work has been delayed considerably by bad weather. J. W. Arthur is superintendent in charge and Fred C. Harwell is manager of the field office.

▸ **O. C. Whitaker Company,** Fort Worth, Texas, had completed (March 3) approximately 90 per cent of the work recently contracted with Interstate Oil Pipe Line Company, which includes 17 miles of 12-in. and 5 miles of 8-in. in southern Oklahoma. The 12-in. is an extension of the company's trunk line from Panther Creek Junction to Oklahoma City. The 8-in. is being laid from a point near Foster to a point immediately south of Elmore City. The field office is at Wynnewood. F. L. Byers is superintendent and J. O. Rogan office manager.

▸ **Smith Contracting Corporation,** Fort Worth, Texas, has completed approximately a third of its part of Shell Pipe Line Corporation's Ozark Pipe Line System (March 3). The contractor is using two spreads to lay the 157 miles of 22-in. pipe ex-

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tending from the Verdigris River, Rogers County, Oklahoma, to Buffalo, Missouri. Field offices and warehouses are at Vinita, Oklahoma, and Neosho, Missouri. F. A. Smith is general superintendent, Fred Peters spread superintendent of Section 3, and H. J. McAdams office manager. Myrl Rumsey, who has been spread superintendent of Section 2, is now in charge of putting in the Grand River crossing. Ben L. Mapes is office manager for Section 2.

Approximately 120 miles has been completed of the 170 miles of 24-in. being laid for The Texas Pipe Line Company between Wichita Falls, Texas, and Cushing, Oklahoma. C. C. Craig is superintendent and H. G. Breckenridge office manager.

▸ **Bill Morrison Construction Company,** Tulsa, Oklahoma, is making good progress on the 95-mile gathering system in the Seminole, Oklahoma, area for Sinclair Refining Company, Pipe Line Department. The system is of 2, 6, and 8-in. pipe and work began January 26. A field office is maintained at Seminole, Henry Arthur being superintendent and Ted Dunn timekeeper.

▸ **E. J. Mahoney Contracting Company,** Mt. Pleasant, Michigan, expects to complete sometime early in June the 75 miles of 12-in. and 20-in. pipe it is laying for Michigan Gas Storage Company. The job consists of 61 miles of 20-in. from Pleasant Lake, Michigan, to Laingsburg, and 14 miles of 12-in. and 20-in. from Laingsburg to Lansing.

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Facilities at Amuay Bay to Be Completed by 1950

Recently opened at the new oil port of Amuay Bay, Venezuela, was a new club for merchant seamen, it was reported. Construction of production facilities at Amuay Bay was originally begun in 1947. By 1950, when development of all port facilities will have been completed, it is estimated that 350,000 bbl of oil will be piped aboard tankers every day for shipment to the United States and to countries abroad. Handling of such vast quantities of cargo will require a turnaround of at least 60 tankers a week, and will mean that approximately 12,000 seamen will visit the port each month. United Seamen's Service announced that it had extended its organization services to this port at the request and with the cooperation of the Creole Petroleum Corporation.

▸ **R. H. Fulton and Company,** Lubbock, Texas, was awarded a contract by Panhandle Eastern Pipe Line Company on February 25 for 74.5 miles of 26 and 30-in. line. Previously (September, 1948) the contractor has been awarded a contract for 114 miles of 26-in. by the same operator. These projects consist of 8 miles of 26-in., at Hugoton, Kansas; 17.5 miles of 30-in. and 17.8 miles of 26-in. from Liberal, Kansas; 36 miles of 26-in. from Pratt, Kansas; 41 miles of 26-in. from Haven, Kansas, and 26 miles of 26-in. from Olpe, Kansas. The Pratt, Olpe, and Haven jobs are now working.

▸ **Massey Pipe Line Construction Company,** Corpus Christi, Texas, will complete about March 25 the laying of 10 miles of 4, 6, and 8-in. pipe for United Gas Pipe Line Company. This is a gathering system southwest of Karnes City, Texas. The contractor has completed 29,500 ft of 10-in. for the same company, laid from the Pierce Estate. In Goliad County, Texas, southwest of Huisache, another project that has been completed is 19,400 ft of 4-in. for W. C. McBride, Inc.

▸ **Sheehan Pipe Line Construction Company,** Tulsa, Oklahoma, is progressing with work on 55 miles of 22-in. being laid for The Texas Pipe Line Company from Patoka to Wood River, Illinois. J. W. Brown is the superintendent in charge.

▸ **Wood Engineering & Construction Company,** Tyler, Texas, has completed work on the 8 miles of 8-in. pipe line laid near Carthage, Panola County, Texas, for Sun Oil Company.

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Split CHILL RINGS
You can
Weld PIPE
•FASTER
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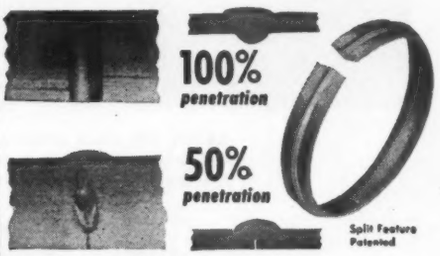
WEDGE Chill Rings with the patented SPLIT Feature offer many advantages in welding pipe and refinery lines. The joints are ordinarily the weakest part of the line but WEDGE Chill Rings REINFORCE them making joints the strongest part of the line. In case



of shock, strain or vibration the pipe will fail before the reinforced joints. WEDGE Chill Rings speed aligning—welding can be done faster and with less material. With stronger joints light wall pipe can be used with safety at a considerable saving.

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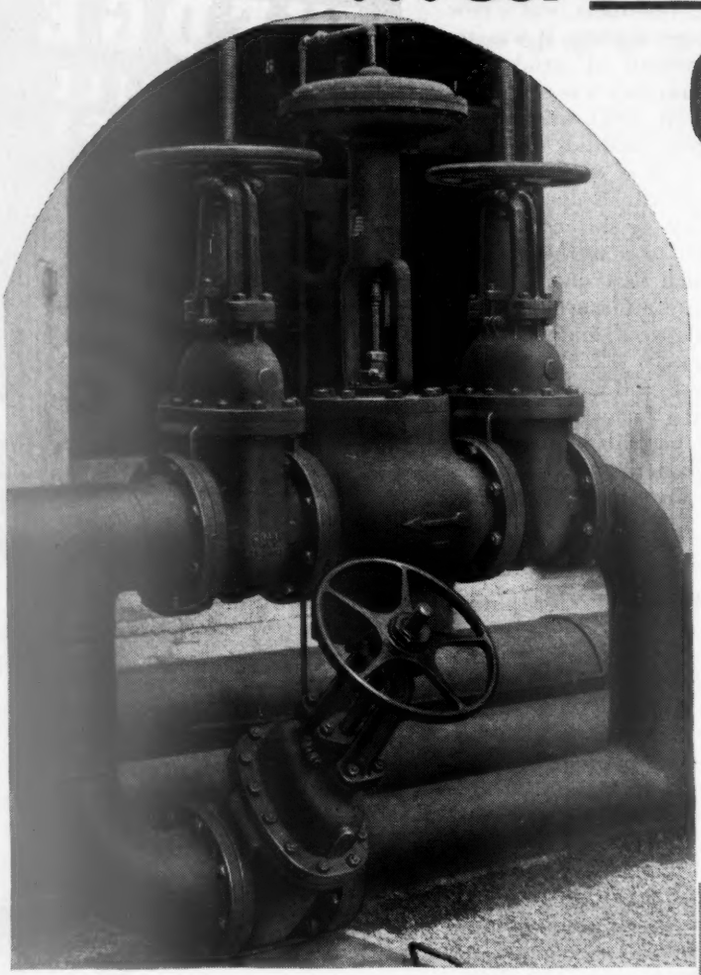

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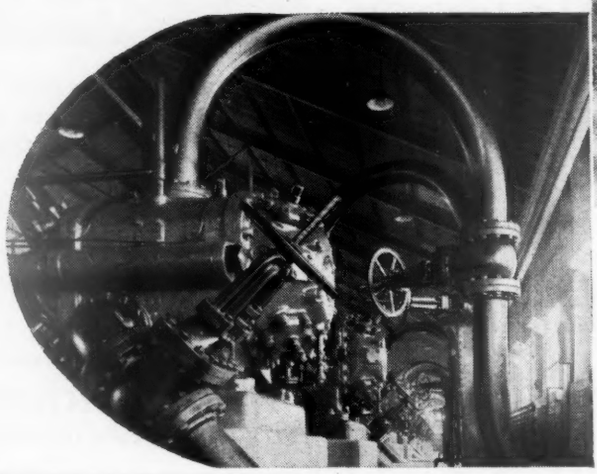
10-IN. PIPE LINE MANIFOLD *featuring Crane iron body gate valves. One order to Crane covers all materials for this installation.*



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PIPE LINE PROJECTS

Trans-Continental Gets Pipe

Trans-Continental Gas Pipe Line Corporation is receiving line pipe for construction of its 1840-mile, 30-in. line from the Rio Grande Valley of Texas to New York City. The first carload to leave Consolidated Western Steel Corporation's plant at Los Angeles, California, consisted of 100 cars, the longest trainload of pipe in the history of the Santa Fe Railroad. The pipe was shipped to McComb, Mississippi, to be stockpiled until winter weather clears and makes possible the beginning of operations.

The line will connect the Rogers Lacy, La Gloria, Jennings, and other natural gas fields of Texas and Louisiana with New York City. More than 470,000 tons of steel will be required to complete the project and the estimated cost is $190,000,000. Initial capacity will be 340,000,000 cu ft a day, but by increasing the number of compressor stations and the compressor capacity in the ten stations presently to be constructed, the capacity can be increased to 505,000,000 cu ft a day, Claude Williams, president, announces.

The line is scheduled for completion early in 1951.

Trans-Continental Gas Pipe Line Corporation recently opened offices in the Niels-Esperson Building, Houston.

Files Application for New York Facilities

Consolidated Edison Company of New York, Inc., has filed an application with the Federal Power Commission in connection with the proposed construction of natural gas pipe line facilities in the New York metropolitan area, asking the commission (1) to find in effect that the company is not subject to FPC jurisdiction, or, as an alternative (2) to authorize construction of the proposed facilities.

Consolidated Edison, which will receive gas from Trans-Continental Gas Pipe Line Corporation after completion of that company's Texas-to-New York City pipe line project, purposes to construct approximately 23 miles of pipe line in the New York area at an estimated cost of $8,250,000.

The company said it has entered into a construction agreement with four other local distributing companies that are to receive Trans-Continental gas, Brooklyn Union Gas Company, Brooklyn Borough Gas Company, Kings County Lighting Company, and Long Island Lighting Company. Under the agreement, Consolidated Edison stated, it will construct and operate a system of mains extending from the Trans-Continental delivery point on the Hudson River at 132nd Street to the plants and individual mains of distributing companies.

FPC Modifies Order

The Federal Power Commission has modified its authorization given to Michigan Gas Storage Company of Jackson, Michigan, in December, 1946, for construction and acquisition of natural gas facilities, by authorizing the company to substitute 20-in. steel pipe for approximately 113 miles of 24-in. pipe line previously authorized as part of a gas storage project.

The FPC order also authorizes the company to install additional compressor units in the Freedom Junction compressor station in Michigan, which would increase the total authorized capacity of this station to 8400 hp instead of the 6400 hp previously authorized, and to construct a 4000-hp compressor station at Laingsburg Junction, Michigan.

The company requested the modification because it was unable to obtain the necessary 24-in. pipe; however,

Pipe Shipments Approved for Trans-Arabian Line

Renewal of pipe shipments to the Trans-Arabian Pipe Line Company has been approved and a license given for export of 25,000 tons of steel during the first quarter of the year. Shipments were suspended 10 months ago due to shortage in the United States and disturbed conditions in the Middle East. This action delayed and almost halted construction of the 1067-mile line.

In anouncing the latest action, Secretary of Commerce Sawyer stated there has been "some easing of the steel shortage." He added, however, that initial shipments to Arabia would not tighten the steel market in this country in any event.

Shipments were suspended in April of 1948 after Senator Wherry and other congressmen protested that the line would be seized quickly by Russia in event of war, and that, also, scarce pipe should be reserved for U. S. requirements. Sawyer said that Secretary of Defense Forrestal, who had promised the congressmen then to "reconsider" the decision allowing steel exports, joined with civilian agencies in the new decision to permit shipments.

In return for the export licenses the Trans-Arabian Pipe Line Company and the three U. S. oil concerns that own it, Standard of New Jersey, The Texas Company, and Socony-Vacuum, have agreed to transport oil for the navy through the line at cost. This will amount to $2,000,000 less per year than the present cost of moving the oil by tankers, Sawyer said.

The line is now due for completion sometime in 1950, about a year behind the original schedule.

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Michigan Gas stated, enough 20-in. pipe will be available in the winter of 1949 and spring of 1950 to complete the project.

The commission also authorized the company to utilize certain pipe line facilities of Consumers Power Company temporarily pending completion in 1950 of the complete 20-in. line. These facilities together with the portion of 20-in. line to be constructed at once will provide an additional connection to the storage fields for use next winter.

The facilities authorized in this instance will be used by Michigan Gas Storage with those previously authorized by the commission for storage of natural gas in the Winterfield and Cranberry Lake gas fields of Michigan, and will permit increased sales for Michigan customers in the 1949-50 winter season.

Texas Eastern Authorized To Increase Facilities

Giving final authorization to Texas Eastern Transmission Corporation for construction of additional pipe line facilities to increase the delivery capacity of the Big and Little Inch Lines by 75,000,000 cu ft a day, the Federal Power Commission has ordered that the additional gas thus made available shall be sold to 12 companies for resale to consumers in Missouri, Indiana, Ohio, New York, Pennsylvania, and New Jersey.

By this action the commission determined that the additional gas flowing through the Inch lines as a result of the new construction should not be sold, as proposed by Texas Eastern, exclusively to three of its present utility customers—East Ohio Gas Company, Peoples Natural Gas Company, and New York State Natural Gas Corporation—known as the Consolidated companies. Instead the FPC decided that the gas should be made available on a basis of need to nine companies that have been seeking supplies from Texas Eastern and that the balance should be sold to the three Consolidated companies.

The facilities that Texas Eastern was authorized to construct include 86,150 additional horsepower at compressor stations on the Inch lines and an aggregate of nearly 75 miles of feeder lines to sources of supply in the gas fields of Texas and Louisiana. These facilities, according to the company's estimates, will increase the delivery capacity of its system from 433,000,000 to 508,000,000 cu ft a day.

East Tennessee Natural To Delay Line Construction

The Federal Power Commission has authorized East Tennessee Natural Gas Company to delay the start of construction on a natural gas pipe line project, previously authorized by FPC, for another six months because of the shortage of steel pipe.

The one-year deadline set by the commission in its original order of February 2, 1948, authorizing the facilities expired February 2. The company recently filed an application with the commission stating that because of the pipe shortage it could not begin construction within the time allowed, and requesting the six-month extension.

The East Tennessee project, estimated to cost $11,470,592, will consist of approximately 186 miles of pipe extending from Tennessee Gas Transmission Company's main line to the Chickamauga Dam area near Chattanooga, Tennessee and a 112-mile line extending on to a point near Knoxville.

East Tennessee has main offices in Chattanooga.

Approximately 17 out of every 20 vessels arriving in New York harbor in 1947 used oil as fuel.

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November, 13, 1948

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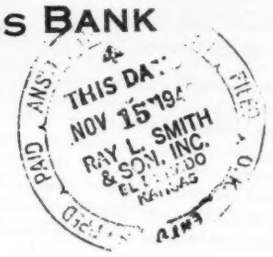

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We did enjoy having your account at this point during your operations in this and adjoining counties, also your consideration of a decent workable balance at all times, Your officers and employees were very nice to deal with and were very considerate of our efforts to serve them well, With all of this handling of funds and in most part all strangers we did not experience and difficulty and the loss was nil, none at all.

Thanking you and trust that if you have reason to come this way again we will be pleased to serve you.

With all kind regards, I am

Respectfully

Vice President

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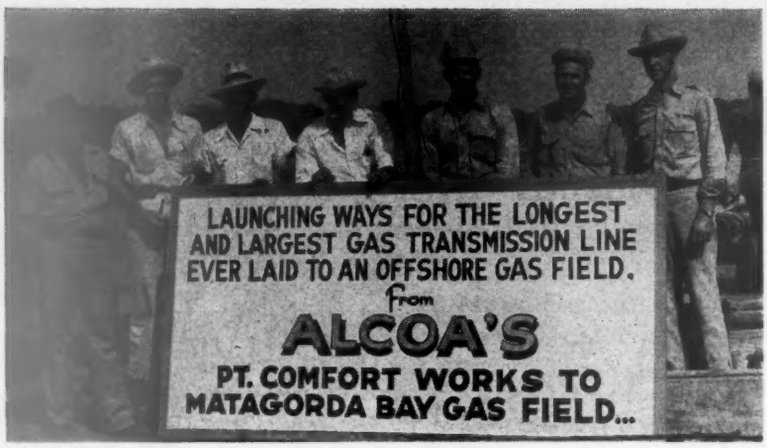


Personnel of Continental Construction Company who were actively in charge of laying Lavaca Pipe Line Company's line to offshore gas fields in Matagorda and Lavaca bays, Texas. From left to right they are: Sammy Collins, vice president in charge of field operations of the company; W. O. Albine, water superintendent; Gene Wright, land superintendent; Jimmy Bergin, material man and expediter; Bill McKinney; Odell McKinney, welding superintendent, and John Cassel, chief clerk and time keeper.

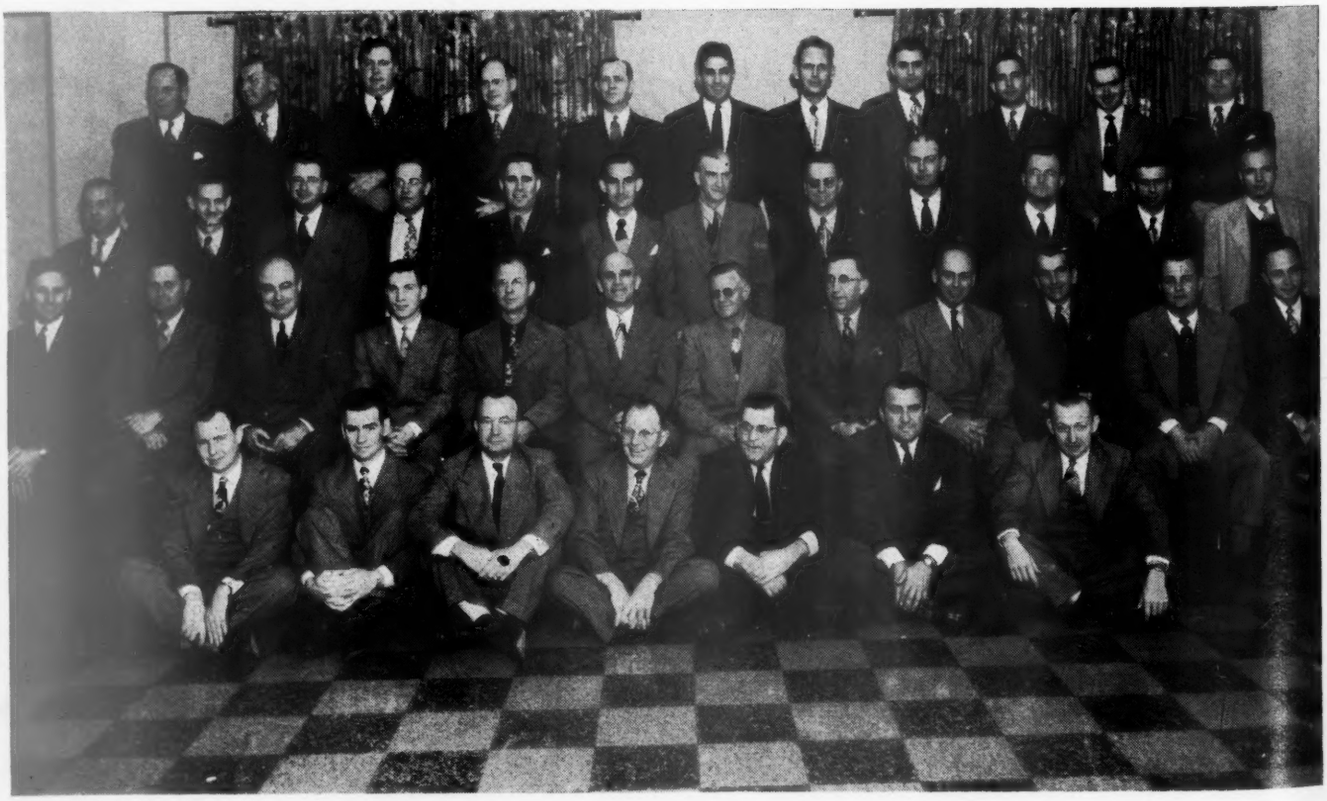
G. G. Griffis Construction Company of Tulsa, Oklahoma, did not have an easy time laying line across Black Dog Lake near St. Paul, Minnesota, for Northern Natural Gas Company, as this picture will attest. The 3600 ft of 20-in. line was laid in 18 below zero weather and the ice had to be shot to make ditch.

Group picture of the Pipe Liners Club of Tulsa. First row, left to right, F. E. McNulty, Koppers Company; E. A. Fuller, Gulf; J. D. Jones, secretary, Gulf; Herman S. Foote, Interstate Oil; P. L. Reichard, vice president, Gulf; J. E. Bercher, Deep Rock; Fred L. Manton, Diesel Power.

Second row: Robert P. Lennart, Stanolind; Jack Vertruse, Standard Pipe Line Construction; J. B. Zachry, Worthington Pump; Clyde O. Johnson, Interstate; R. L. Bullock, Interstate; George B. Randels, Interstate; G. S. Bancroft, Interstate; W. C. Paynter, Great Lakes; F. V. Cook, Stanolind; T. S. Llewellyn, Stanolind; Jack Johnson, Westcott & Greis; J. R. Ellis, Sunray.

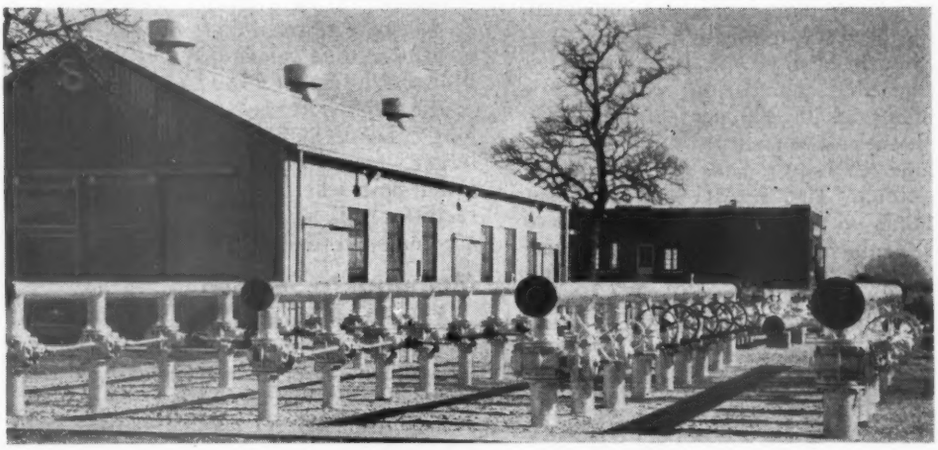
Third row: Francis Coryell, Interstate; C. F. Luckfield. Stanolind; Joe C. Rawlins, Interstate; W. F. Davis, Interstate; Roy O'Neal, Harley Sales; R. A. Darling, Cooper-Bessemer; Dallas S. Deem, American Air Filter; F. C. Whiteside, treasurer, Interstate; R. F. Ezzell, Great Lakes; Gus L. Maciula, Stanolind; R. W. Clements, Stanolind; C. F. Gearhart, Jr., Stanolind.

Fourth row: Dallas T. Lutters, Interstate; J. D. Bowers, Interstate; Sam C. Phelps, Interstate; Fred N. Taylor, Shell; J. F. Nickell, Wilcox; C. N. Elbert, Jr., National Tube; G. P. Jennings, Phillips; Dean B. Taylor, Phillips; D. A. Roach, Phillips; Fred B. Crandall, Phillips; Milton E. Worlow, Phillips.



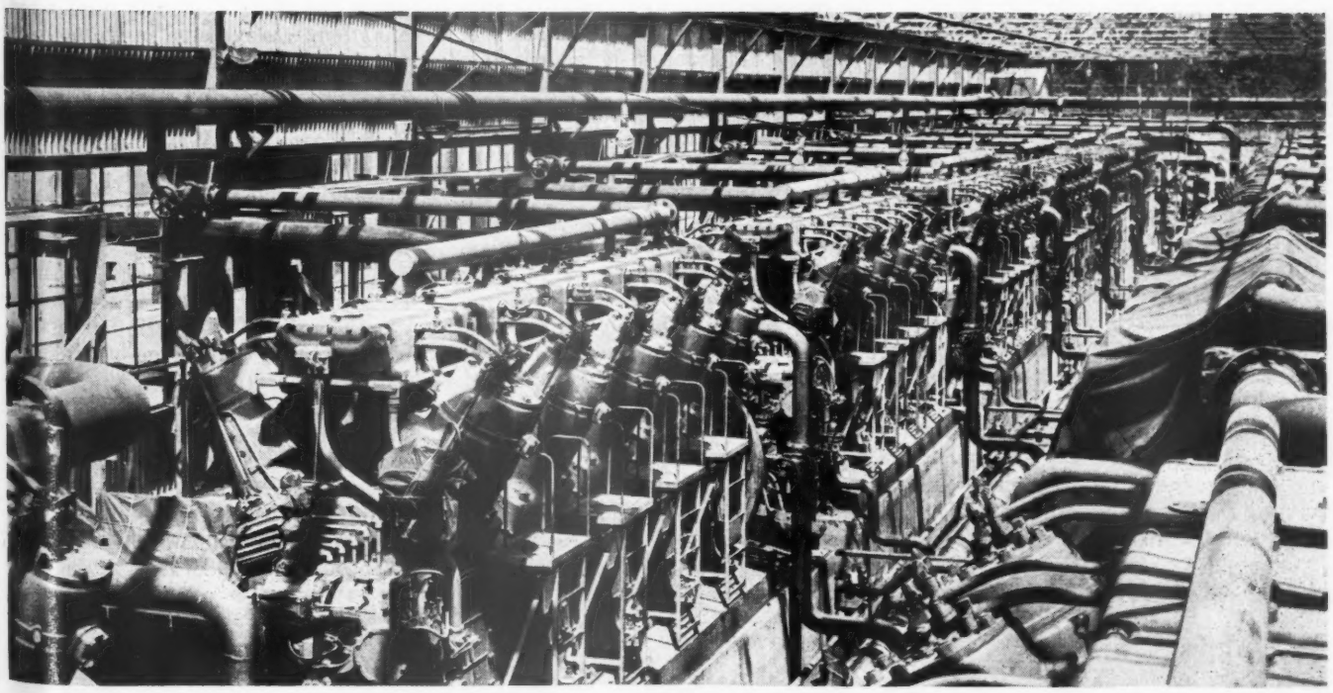
Pictorial

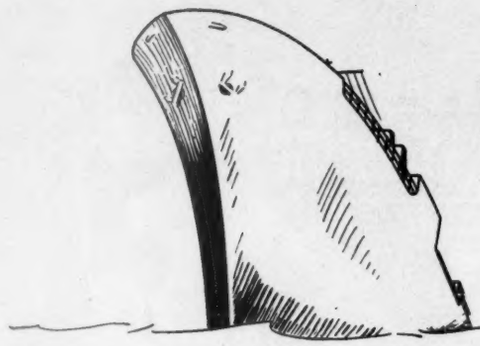
Yuma, Arizona, is now receiving natural gas as the result of a line laid to that city by El Paso Natural Gas Company, which is making delivery to Arizona Edison Company, the distributor. The group that attended the ceremony making the first delivery is shown: Kneeling, Jack McDonald, new business manager, Arizona Edison; Dale Cox, commercial manager, Edison Yuma office; John Fairweather, secretary of Yuma C. of C.; J. B. Rolle; W. S. Ingalls, mayor of Yuma; F. C. Braden, president of Yuma Chamber of Commerce. Standing, left to right: T. T. Parker, gas superintendent of Arizona Edison properties; M. P. Goudy, district supervisor, Yuma Arizona Edison; Ray Smucker, radio station KYUM and president of Yuma Junior Chamber of Commerce; Jones Osborne, publisher of the *Yuma Daily Sun*; Dave Branch, Yuma Edison plant superintendent; W. G. D. McElrath, superintendent of El Paso Natural Gas Company's Ehrenburg district; Reid Gardner, president of Arizona Edison; Max Llewelyn, general superintendent of Arizona Edison; Harold Breech, chief of police of Yuma; C. F. Rittmann, Jr., superintendent of measurement, El Paso Natural Gas.



Arlington, Texas, station of Sinclair Refining Company, pipe line department, with suction and discharge headers in foreground, pumphouse at left, control building in background.

Fourteen Cooper-Bessemer compressors installed at Texas Eastern Transmission Corporation's Bald Knob, Arkansas, compressor station. Each of the engines develops 1100 hp. (See article this issue).





MARINE OPERATIONS

Federal Budget Provides Funds for T-5 Tankers

Within a fortnight after the delivery of President Truman's budget message for the fiscal year 1950, the Maritime Commission revealed that, subject to funds being made available by Congress, it was prepared to announce proposals that would induce private capital to construct and maintain in operation in commercial trades for a period up to 20 years, unless lost, 15 tankers of the T-5 class. These NDF tankers would be subject to immediate purchase or requisition by the Government at any time. It was reported that the commission would allow about $2,500,000 per ship for high speed and certain features not customarily required for commercial operation. The USMC has sufficient funds on hand to start work on five T-5's during the first half of this year. For the fiscal year ending June 30, 1950, the Federal Budget requests $100,000,000 for the USMC to use in ship construction. The maritime agency stated that it would earmark funds for ten tankers from this fund should Congress follow the President's recommendation. The characteristics of the T-5-SD-U1 are: 660 ft by 83 ft by 46 ft 6 in.; 29,500 tons deadweight equalling 36 ft 9 in. Capacity (cargo tanks) will be 217,000 bbl.

White Paper Projects Future U. K. Tanker Fleet

A recent issue of the White Paper in Great Britain, which referred to the long-range program of the United Kingdom submitted to the Organization for European Economic Cooperation, states that, by the end of 1952, Great Britain's ocean-going tonnage of dry cargo vessels will have nearly reached the prewar level and that the tanker fleet will be considerably above what it was in 1939. By the end of 1950, the White Paper continues, substantial progress will have been made in this direction. Assuming the minimum allowance for obsolescence, new construction for the United Kingdom register will bring the dry cargo tonnage up to a figure of 12.8 million gross tons by the middle of 1950 and the tanker tonnage to a figure of 3.8 million gross tons.

The principal problem of the United Kingdom, so far as tankers are concerned, is to produce enough tankers for the British oil companies to carry their increased trade. Great Britain's tanker fleet has already passed its prewar volume, and an increasing proportion of shipbuilding capacity will be employed in building tankers during the next four years. The British tanker fleet at the end of 1952 should be 4.3 million gross tons, or 900,000 tons more than the end of 1947, and well above that of 1939. As more oil supplies have to be carried on the long haul from the Middle East, larger, faster tankers operating at lower cost will be needed and port facilities will have to be adapted to accommodate them.

Memorial to Seamen

A memorial honoring the 141 men of Sun Oil Company who lost their lives aboard tankers sunk or damaged during World War II will be erected at the entrance to the company's Marcus Hook refinery.

Names of the men who died at sea following German submarine attacks will be inscribed on bronze plaques on the sides of granite pedestal supporting a bronze statue of a seaman.

Names of the four Sun tankers sunk by Nazi torpedoes will also be borne on the plaques. A fifth Sun ship exploded in New York Harbor while engaged on a war mission.

To provide a proper setting for the memorial an extensive beautification project has been started at the refinery entrance. This work includes clearing the area for a park, widening of a street, building of a new brick gatehouse and gateway with wrought iron fence, and a new driveway.

Trees and shrubbery will be planted to give the area the atmosphere of a park.

Sun employes contributed $29,524 toward the cost of the $17,472 project. The memorial is expected to be completed next fall when a dedication ceremony will be held.

Record Shipments by Great Lakes Tankers

During the 1948 lake navigation season, shipments of petroleum products via Great Lakes tankers kept pace with the movement of dry bulk cargo. Final figures for tanker shipments show that a new all-time record was attained, surpassing in volume the previous high of 1947, and in tonnage the earlier mark of 1946.

Despite some concern during the early months of the season, the movement exceeded preliminary expectations as the result of generally favorable weather and navigating conditions and the inclusion of three new tankers of Canadian registry during varying parts of the season.

Final tabulations show that shipments of petroleum and its derivatives aggregated 78,720,070 bbl, the equivalent of 10,995,745 net tons, representing an increase in tonnage of 7.99 per cent over the 10,145,1000 tons transported in 1947.

Cut in Time for T-2 Strapping Operations

Discussion on the comparison of strapping costs of T2-SE-A1 tankers concerning costs in American repair yards and those quoted in the United Kingdom was renewed in the news of two vessels recently reporting for survey and repairs, and strapping at the yard of Swan, Hunter and Wigham Richardson, Ltd., Wallsend, England. The vessels were the T-2 tankers *Beecher Island* and *Smoky Hill*, both owned by British Tanker Company, Ltd. Experience from a tanker strapped earlier in the year at a British yard gave rise to suggestions for greatly curtailing the period necessary for the fitting of the eight 12-ft by 1-in. riveted straps. The suggestions were accepted by the classification society and the owners, with the result that the time taken for the new job was reduced from a little over 5 weeks to 15 days for the *Beecher Island*, and 13½ days for the *Smoky Hill*, representing a considerable saving for the owners.

Another Supertanker Will Be Launched April 1

Another supertanker, *Imperial Alberta*, of 26,550 dwt, will be launched April 1 by the Sun Shipbuilding and Dry Dock Company at the Chester, Pennsylvania yard for Imperial Oil, Ltd. The *Imperial Alberta* will have a volumetric cargo capacity of 228,000 bbl and a designed speed of 16 knots. Dimensions are: 600 ft long, 82 ft 6 in. beam, and draft of 31 ft 10 in. The tanker will carry Middle East crude oil to Portland, Maine, terminus of the Portland-Montreal pipe line or to Halifax, it is reported. Commissioning of this new supertanker will bring the Imperial Oil fleet to total of 10 ocean-going tankers and one coastal tanker. In addition, the company operates 17 vessels.

Seria Offers Facilities For Loading Tankers

Shell Oil Company is reported to be engaged in Brunei, a British dependency in northern Borneo, in the development of oil fields that may become the most productive oil fields within the British Commonwealth. Present plans of Shell indicate extensive operations are centered primarily around Seria. Seria maintains a strategic importance since it offers at present the only facilities in this area for loading oil on tankers. Sea lines extend about 2½ miles out from the shore at Miri, where the tankers load on an average of 9,000 to 12,000 long tons. Oil tankers are unable to approach Seria, therefore oil must be pumped through pipe lines to Lutong, Sarawak, where the refinery is situated. From here the refined oil is pumped a distance of three to five miles to Miri.

British Tanker Launched

Building to the order of the British Tanker Company, Ltd., the tanker *British Prudence*, carrying about 12,500 tons deadweight, has been launched by the Blythswood Shipbuilding Company, Ltd., Glasgow. Hugh M. MacMillan, chairman and managing director of the yard, referred to the *British Prudence* as being the fortieth tanker of about the same size that has been built by the company. According to the director, the parting of the ways has been arrived at with regard to size of oil tankers, because a great many of the vessels of the type that they are building range from 20,000 to 30,000 tons deadweight. "The bigger the ship, the cheaper she is per ton deadweight carried, provided one can fill and use the capacity," stated MacMillan.

Inland Tanker Acquired From U. S. Is Remodeled

A new 250-ft tanker, renamed the *M. V. Tycol*, has been added to the East Coast inland fleet of the Tide Water Associated Oil Company, it was announced by R. K. Kelly, manager of the company's eastern division marine department.

Formerly the *M. V. Ochlockonee*, the tanker was purchased from the U. S. Government, and was overhauled at the Bethlehem Steel Company shipyard at San Francisco, where she had been laid up. Tide Water Associated removed her wartime gun placements and armaments and cut the ship in half to insert a new 3000-bbl, 30-ft tank amidships. This increased the ship's capacity to approximately 15,000 bbl and her overall length to 250 ft, while it actually decreased the draft by 5 in.

The tanker, of modified T-1 design, was built in December, 1944, for the U. S. Maritime Service at the East Coast Shipyards, Bayonne, New Jersey. She will carry a crew of 17 men and is expected to transport gasoline, kerosine and light fuel oils between Tide Water Associated's refinery at Bayonne, to the company's bulk terminals along the Hudson River as far as Albany, and Long Island Sound.

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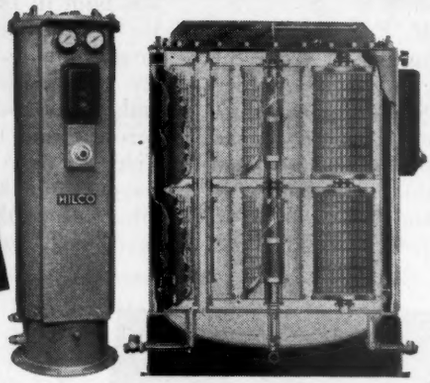

- For lube oil using one or a multiple of 11" x 18" Filter cartridges easily handled by the operator, offering large filter area and proper depth to assure complete saturation of filter material. Available with and without heaters.

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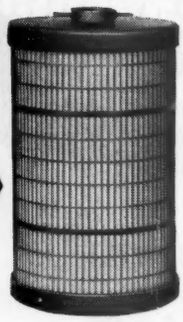

*Both are interchangeable at any time.

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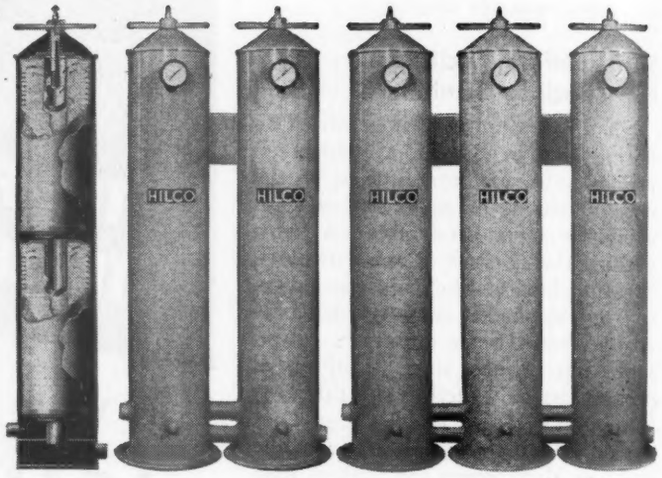

- Hilco Hyflow Oil Filters use Hilite-Fuller's Earth for filtering straight mineral and fuel oil or Hiltex-Cellulose, the all-purpose filtering media for heavy duty detergent oils and fuel oil.

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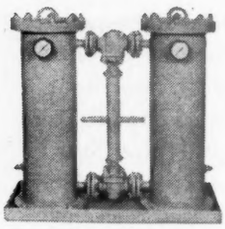

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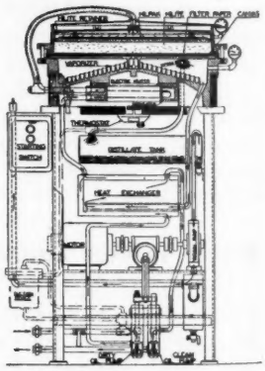
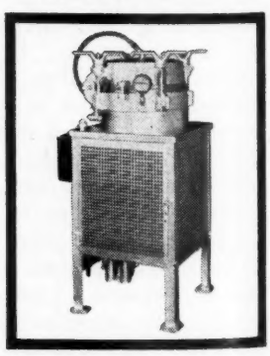


- For direct connecting to one or more engines for perfect and complete lube oil purification—removing carbon sludge, abrasives, tarry matter, and acids, water and fuel dilution—and color restoration.

Hilite-Fuller's Earth for filtering straight mineral oils—ADSTAY DISCS for heavy duty detergent oils.



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(1) Decanting Gear

Worthington Pump and Machinery Corporation announces a new decanting gear used for automatically lowering the swing-pipe decanting tube in the chemical agitating tank to feed chemical to the softener in proportion to the raw water flow. Its operation is paced by the raw water meter.

The drum is driven through oil immersed gears by a 1/40 hp synchronous motor inclosed within the housing. The motor operates on 110 v, 3 phase, 60-cycle current, although 50 or 25-cycle design can be furnished.

(2) Pipe Threader

Armstrong Brothers Tool Company has released their No. 165 portable power pipe threader. This power threader is operated by any ½-in. standard electric drill. Threads 1-in., 1¼-in., 1½-in., or 2-in. pipe with one set of high speed steel chasers—weighs only 26 lb and one man can carry it from job to job with ease. Threader is furnished complete with one set of high speed steel chasers and drive adapter.

(3) Electric Diaphragm Valve

General Controls Company has designed an electric diaphragm gas valve for reliable control of natural, manufactured, mixed and liquefied petroleum gases to space and unit heaters, furnaces and boilers.

Valve is silent and has low current consumption of 5 watts. Of packless construction, all body parts are die formed aluminum of high density and tensile strength. The valve is available in two small sizes, ⅜-in. and ½-in. ips, diam 2¾-in.; two medium sizes, ½-in. and ¾-in. ips, diam 3⅞-in. and three large sizes, 1-in., 1¼-in. and 1½-in. ips, diam 5¼-in.

(4) Fluid Coupling

Gyrol fluid coupling is now available on certain Chrysler industrial engines, according to the Industrial Engines Division of Chrysler Corporation.

The coupling, complete with clutch, clutch housing and either a 3 or 4 speed transmission is offered on Models, 5, 6, 7, 8 and 12 of the industrial engine line.

The gyrol fluid coupling provides a safety cushion between the source of power and the load. Other advantages of the fluid coupling are longer clutch life and the ease of handling a particular piece of equipment.

The coupling permits the engine to be accelerated close to the torque peak with the output shaft turning at a lower speed. The necessity for declutching for brief periods when operating the engine without load is eliminated.

(5) Depthometer

A complete description of the Depthometer, its operation and function, has just issued by The Cavins Company of Long Beach, California. This device is designed for the automatic measurement of wire line paid out into the hole or withdrawn from the hole, under almost any conceivable set of conditions. The Depthometer is light, portable, and is invaluable for the location of fish, or for the determination of any depth.

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NAME..... TITLE.....

COMPANY NAME.....

STREET ADDRESS.....

CITY..... ZONE NO..... STATE.....

(6) Shale Separator

A new type shale separator, designed and manufactured by Thompson Tool Company, is being tested in North Texas fields. This new separator is made primarily for deep hole operations but is readily adaptable to all drilling requirements.

It handles with uniform effectiveness any mud volume coming from the well.

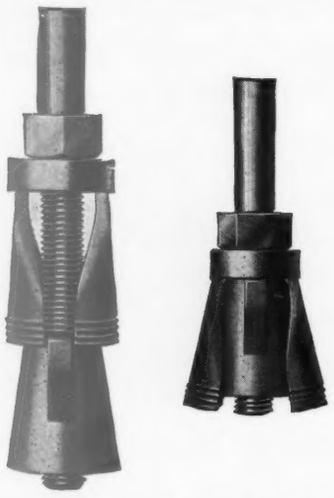
The Thompson separator incorporates the use of a ¾-hp electric motor that performs the dual role of pumping mud from the bottom of the separator to spray the screens on the separator and also turning the screens for proper shale separation and mud recovery.

An entirely electric separator to be known as Model EW is going into production soon at Thompson Tool. All power will be supplied by an electric motor.

The manufacturer, however, also expects to continue to build the other three models of separators and the motor and pump can be added as an attachment.

(7) Rock Anchor

The Rock Anchor manufactured by the GripOTite Manufacturing Company, meets a demand of the industry for a positive and permanent hold down for pipe line construction in solid rock, foundation bolts and many



other applications. It is made of certified malleable and is so constructed that when load is applied, expanding forces anchor wings against the walls of the hole to effect a positive grip at all times. Corrugations on the bearing surfaces of the wings prevent any slippage. The standard 2-in. size expands to 2⅝ in. and is equipped with ¾-in. rod. Standard 3-in. size expands to 3⅝ in. and is equipped with 1-in. or 1¼-in. rods. Actual tests of 2-in. size show a rod breaking strength of 20,000 lb; no slippage in the anchor.

(8) Oil Purifier

The Houdaille Purivac unit, manufactured by Honan-Crane Corporation, a subsidiary of Houdaille-Hershey Corporation, is a new addition to their line of oil purification equipment.

This unit is a complete system for purifying, dehydrating and degasifying insulating oil either in the field or at a central station location. The Houdaille Purivac is designed for two stage operation; the first—for purification of the oil to remove oxidation products and foreign contaminants; and the second—for dehydrating and degasifying the purified oil to provide for complete removal of moisture and entrained air as may be required.

(9) Steam Hose

United States Rubber Company has developed a steam hose for pile drivers used in building wharfs, bridges, railroad trestles and other heavy construction work. The hose is constructed of a rubber core especially compounded for oil resistance, two or three plies of braided steel wire, depending upon the diameter of the hose, one ply of asbestos cord, and a heat resistant rubber cover.

(10) Oil-Emulsion Mud

For top hole drilling, a new oil-emulsion mud to be known as White Magic has been introduced by Oil Base, Inc., makers of Black Magic oil base drilling fluid. When added to a water-base clay mud, with crude or refined oil. White Magic produces a low water loss mud with excellent viscosity and gel properties, capable of being built to any desired weight up to 130 lb per cu ft (17.3 lb per gal). When desired, it is possible to obtain a zero API fluid loss with a white magic emulsion.

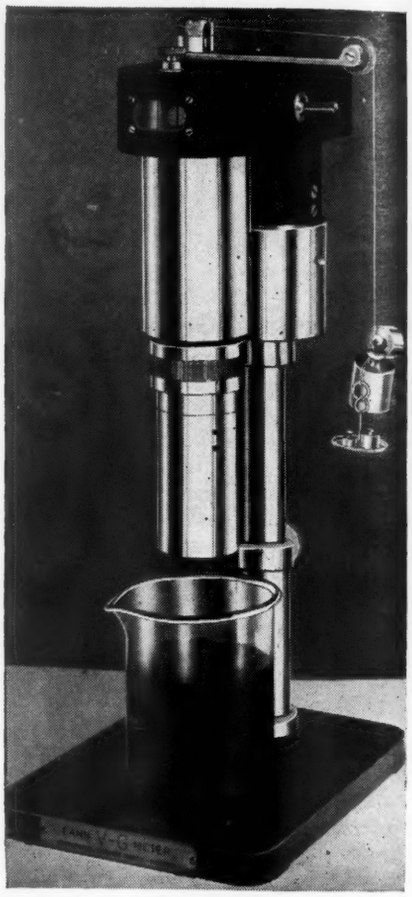
White Magic requires no extra equipment. White Magic gives lubricating qualities to water base muds. It helps lubricate bit bearings, reduces drill pipe torque. It is electrically conductive and accurate electric logs are obtained with normal survey equipment. White Magic forms a paper-thin, tough, pliable mud cake that tends to prevent washouts and to keep heaving and hydrous disintegrating shale in place. It is little affected by cement, salt, limestone, gypsum and anhydrite. Control of White Magic is the same as for conventional water-base muds.

Better cores and greater core recovery are possible because of low water loss. Flushing action is less and core analyses more accurate. White Magic keeps a hole to guage and cementing jobs are frequently better, especially through shale zones where washouts and cave-ins have been prevented.

(11) V-G Meter

The Fann V-G meter by the Geophysical Manufacturing Works is a strong, dependable instrument for the most exacting measurements of drilling muds and other fluids. Readings are easily converted to centipoises. It is designed for laboratory or field use.

Both field and laboratory models use the same measuring mechanism



and field results are reproducible in the laboratory. The calibration curve is a straight line which makes it a simple matter to convert readings to centipoises without the use of a chart. Sustained rates of shear are made possible by the use of an electric motor drive.

No timing devices are required and usable readings may be obtained by the most inexperienced help. Small in size and easily carried, they are ideal for portable laboratories and hand kits.

(12) Centrifugal

Goulds Pumps, Inc., Seneca Falls, New York, have announced a new centrifugal specially designed to pump clear liquids. The advance design gives compact simple construction with high operating efficiency, ease of installation and maintenance. It is available in 14 sizes for both motor and belt drives with capacities from 10 to 1800 gpm with heads to 120 ft.

WHY DO YOU CALL IT A *Derrick?*

That word you use so often—Derrick—had an origin far removed from the oil country. It is traced to the seventeenth century. A hangman of Tyburn, near London, was named Derrick. Derrick built a gallows which was dubbed "the three-legged mare" and "Tyburn tree." Thereafter, such structures came to be known as "Derricks."

Continental is another name well known throughout the oil country. It's a name that for more than 36 years has come to be known to mean quality equipment and good—*good*—service.

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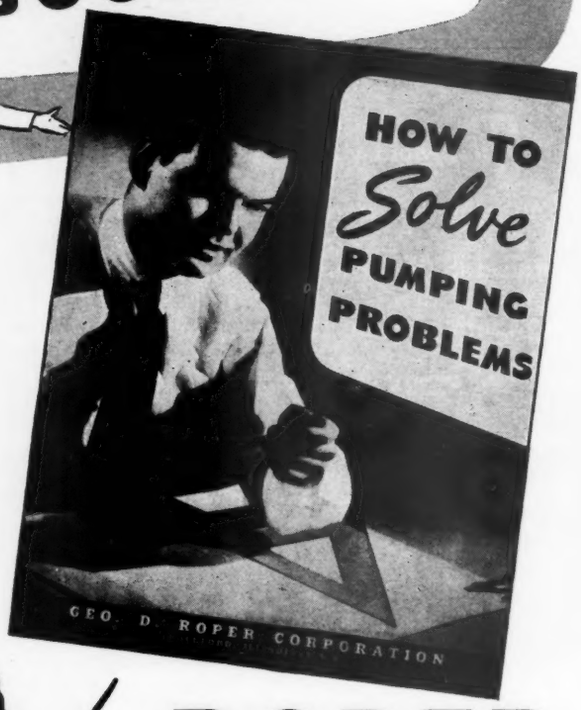

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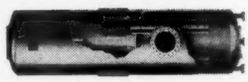
(13) Packless Valve

Magnilastic division of Cook Electric Company, Chicago, Illinois, has developed a standard series of corrosion resistant metal bellows of all-welded construction which seal valve stems against any and all corrosive agents. These bellows-sealed valve stems are designed and adapted to a wide range of valves manufactured by a number of valve manufacturers. Packless bellows-sealed valves of corrosion resistant alloys give greatly extended protection from leakage traceable to corroded seats, stems, and packing.

(14) Air Cleaner-Snubber

Development of a new line of combination air intake cleaner-snubbers has been anounced by Burgess-Manning Company, Libertyville, Illinois. They are used on all 2- and 4-stroke



cycle stationary engines (diesel, gas, or dual fuel). They are also used for the intake of all centrifugal and positive displacement compressors and blowers requiring a compact combination intake air cleaner and snubber. Designated as Series SDF, these units are available in pipe sizes from 8 to 30 in., inclusive.

The cleaner-snubber is a combination unit which combines intake air cleaning and noise prevention. This snubber replaces an intake snubber plus a supplementary intake air filter. The SDF series is provided with two alternate connections to the engine intake.

(15) Handi-Crane

To meet the demand for a fast, powerful and maneuverable machine that will reduce material handling costs, the Clyde Iron Works, Inc., Duluth, Minnesota, now offer the all-purpose, Clyde Handi-Crane.

Mounted on a Model UTI, Minneapolis-Moline tractor, the Clyde Handi-Crane can pick up a load and carry it wherever a tractor can go. It has a high lifting capacity of 4 tons, yet it has exceptionally easy steering due to its special steering gear with roller bearing knuckles. The small, compact size allows it to work in congested areas . . . it revolves 320 deg so that loads can be picked up, carried or spotted on either side with safety and precision.

The all-steel, welded boom is raised and lowered by means of a hydraulic cylinder that permits independent boom topping at all times.

(16) Self De-Icer Hydrant

A new design in "frost-proof" hydrants, eliminating the need for underground pits, gravel boxes, drainage lines, sump pumps, special insulation and electric heating coils has been introduced by Crane Company. Water is allowed to remain in and to freeze in the portion of the hydrant above the frost line. No water is drained off below ground. The key to this design is a rubber-lined riser-spout. Inside the riser-spout, for the entire length of the hydrant to well below the frost line, is a rubber tube. When the valve is opened, the water flows through this tube. With the water pressure turned on, the rubber tube expands against the inside of the riser-spout, allowing a full column of water to flow. As soon as the water pressure is turned off, the rubber tubing, which is installed under tension, contracts to an internal diameter not much greater than the thickness of a lead pencil. In cold weather the thin column of water inside of the tube freezes down to the frost line. Whenever the valve is opened, water pressure again expands the tubing; and water flows up and around the "pencil" of ice. The ice breaks up and flushes out with the water, giving a free-flowing stream almost instantly.

(17) Rigging Aids

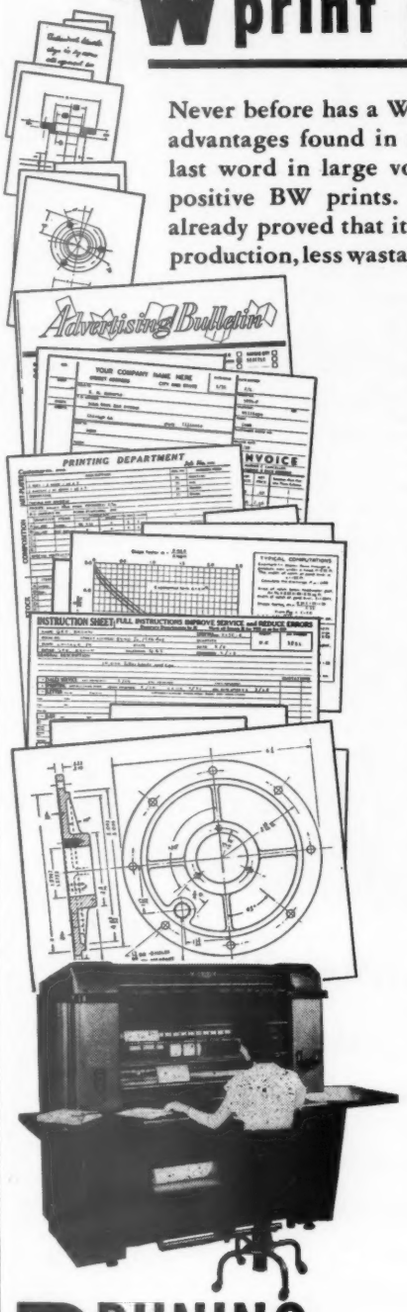
Fellows and Stewart have announced the perfection of two new rigging devices for the splicing of wire or fibre rope. The first of these is the splicing vise for wire rope from $\frac{1}{8}$ to $\frac{1}{2}$-in. in diam. The new vise holds wire firmly in place while being spliced, either in a stationary position or with a free swivel motion at the discretion of the operator. The Stewart rigger's fid is used like an ordinary marline spike except that a detachable hollow handle holds the rope strands apart and allows the easy insertion of the incoming strands.

(1) Shut-Off Valves

New improved models of the Warden automatic low pressure shut-off valve incorporating a precision lapped synthetic rubber seat which provides for positive closure are announced by the Security Valve Company of Los Angeles, California. They are recommended for use on gas or fluid lines where closure is desired when pressure fails from any cause.

The simple mechanical action is entirely self-contained and is accurate and dependable. Its mechanism is not dependent on external actuating forces. A distinctive feature of the Warden valve is that it must be reset manually after closure.

large volume BW print production



Never before has a Whiteprinter been able to offer you all the advantages found in this new Volumatic Model 93. It is the last word in large volume production of high quality direct positive BW prints. Advance models of this machine have already proved that it reduces reproduction costs . . . by faster production, less wastage, lower maintenance, simpler operation.

It has countless uses. The Volumatic, like other Bruning Whiteprinters, produces sharp, highly legible copies of engineering drawings and documents . . . anything that is printed, drawn, written or typed on a translucent medium. Its uses increase daily as more and more business and industries turn to the BW Process to eliminate the costly practice of transcribing documents, forms and records of all kinds.

It is extremely versatile. The Volumatic Model 93 produces sharp BW prints from post card size up to 42-inches wide and unlimited length. You can have light, medium or card weight prints . . . prints on tinted stocks . . . prints on film or cloth . . . prints with colored lines.

Anyone can operate it. The operation of the BW Model 93 has been simplified to the point where a girl can learn to operate it in less than an hour.

Faster operation. The new Volumatic produces BW prints up to 105 square feet a minute *at normal operating speeds.* The prints are delivered dry and ready for instant use.

Completely odorless. The BW Process is completely odorless. BW machines do not require outside ventilation or exhaust ducts. They can be installed *anywhere* without offense.

It is mobile. There are no pipe or plumbing connections to tie this machine to one spot. It can be moved easily to convenient locations.

Uniform quality control. BW Model 93 automatically and instantaneously coordinates developing and printing speeds. Changes in printing speed never result in over or under developed prints. A further safeguard to quality is Bruning's built-in constant voltage transformer which assures uniform operation of the machine although line voltages may vary from 190 to 250 volts AC.

Send today **for full information.** Let us send you a complete file of literature describing the new BW Model 93 and the BW mediums you can use with it. See for yourself the extreme versatility, economy and speed of this machine. There is no obligation.

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GAS AND OIL LINES • GAS AND OIL GATHERING LINES • WATER
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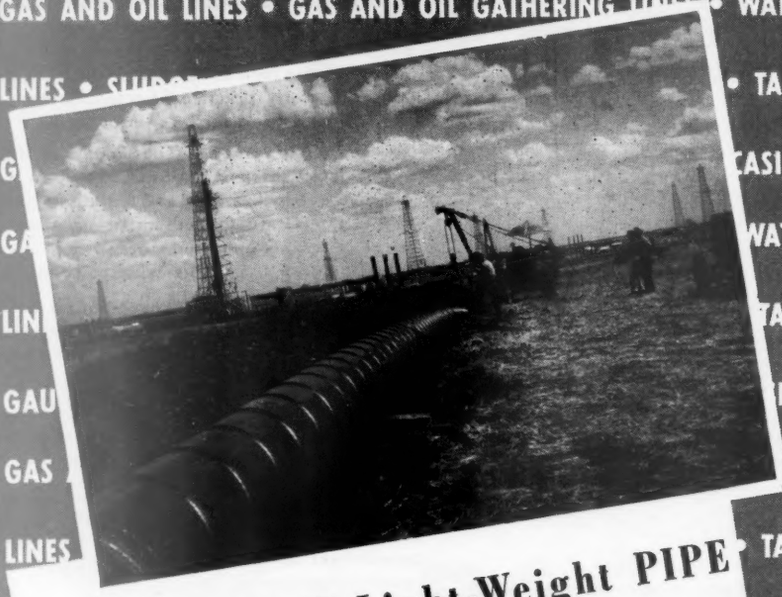

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. . . and it's different from all other light-weight pipe because it is built with the Lockseam Spiralweld structure that provides a reinforcing truss for greater strength, extra safety and better all-around performance. That's why Naylor is preferred on applications like those listed here. Sizes from 4" to 30" in diameter with all types of fittings, connections and fabrications.

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(19) Kellogg Key-BX System

Most recent of communications products introduced by the Kellogg Switchboard and Supply Company, Chicago, Illinois, is the new Kellogg Key-BX system. Designated as No. 6-2-20 system, the Key-BX incorporates a wiring plan that makes subscribers telephone service more flexible and greatly increases efficiency. For companies requiring several simultaneous outlets to the main exchange this system is the answer to improved and efficient telephone service. Each individual is his own attendant and has access to all incoming and outgoing trunks, and can call any individual in the organization connected to the Key-BX system.

(20) Insulation

Zerolite is a low temperature insulation with exceptional fire and chemical resistant qualities announced by Johns-Manville and now available nationally in the form of sheets, lagging and pipe insulation. Zerolite is especially designed for service within the temperatures of minus 400 F and plus 250 F. It is classified as fire resistant and will pass the hot rivet test as described in Maritime Commission specification 32-MC-2. The many organic solvents to which Zerolite is immune include benzol, methyl ethyl ketone and petroleum fractions and derivatives.

As to moisture resistance, Zerolite shows a moisture absorption of 0.0 after 96 hr in air of 75 per cent relative humidity, and a water absorption of only 2.0 per cent by volume after being submerged for 24 hr.

The low heat conductivity values for Zerolite at several mean temperatures are .28 at 70 F, .25 at 0, and .22 at —70 F.

(21) Core Tubes

The complete line of Extrulite Core Tubes for protecting, storing and transporting conventional oil well cores is now available in the Mid-Continent and Rocky Mountain branches of the Reed Roller Bit Company.

These light weight core tubes provide a new method of handling oil well cores. Possibility of mixing or reversing samples has been eliminated by inserting all pertinent data on a label which is readily visible from the outside of the tube.

Tube diameters range from 1 to 4¼ in. and standard length for storing purposes is 36 in. Any length tube is available on special order. Solvent to provide an air-tight seal, and light weight metal and plastic carrying cases are available.

(22) Instrument Transformer

An instrument transformer designed for outdoor service and suitable for operating meters, relays, and control devices has been announced by General Electric's meter and instrument divisions.

Designated as the Type JEA-3, the potential transformer is of sealed construction and can be mounted in any position—vertical, horizontal, or inverted. The JEA-3 is available in ratings of 2400:120 volts and 4800:120 volts, 60 cycles. Both of these types have insulation for a 60-kv, full wave impulse level.

(23) Telephone System

Designed for simple convertibility, the wire-line or radio-link Type 33 Carrier System of Lenkurt Electric Company permits the installation of a single channel by itself and later addition of one or two more channels as required. Type 33 channels can be stacked on existing single-channel systems of many types. Because it is primarily intended as short-haul equipment, emphasis has been put on minimizing cost. This makes its installation economically feasible on lines as short as 10 miles.

Loop gain of a Type 33 terminal is 30 db which represents the spanning of distances up to 250 miles of wire line without repeaters. Systems can be extended by the use of repeaters which give 25-db gain. A separate full-duplex two-way signaling channel is included, which will operate over circuit attenuation as great as 40 db. Operation can be changed from ring-down to dialing by the replacement of plug-in relays.

(24) Automatic Burners

The Peabody Engineering Corporation burner unit comprises a complete system of fuel oil pumping and preheating, fuel oil pressure and temperature regulating constant differential mechanical atomizing oil unit all mounted on a rigid steel frame, ready to be bolted to the furnace front plate.

The burner is equipped with a complete system of electrically actuated fully automatic safety controls consisting of gas-electric ignition, electronic flame failure protection, solenoid fuel oil shutoff valve, steam pressure limit switch, gas pressure cut-out switch, low fuel oil temperature cut-out switch, and low fire start after each burner shut down.

The fan and fuel oil pump are driven by the same motor. The fuel oil pump is a slow speed heavy duty type which takes its drive through the speed reduction gear of the motor thereby assuring steady pump performance and long life with No. 6 oil.

HELICOID PRESSURE GAGES are now made in smaller size for pumps, compressors, engines, etc. Same high quality—same design and construction as larger sizes. All these Helicoid advantages:

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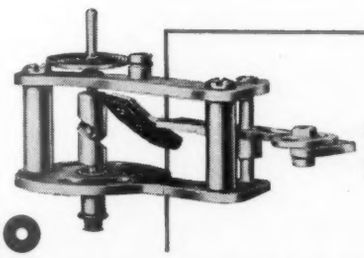

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TYPE SL SINGLE WALL LADDER

For all-around industrial use. Type SL wall ladders range from 6 to 36 feet. Write for complete specifications and prices for Type SL and other ORIGINAL Aluminum Industrial Ladders.

Aluminum Ladder Company

271 CARBIS ST., WORTHINGTON, PA.

(25) Winter Grease

A soft consistency grease for winter use in heavy duty industrial service has been developed by The Texas Company. The new H Grease O has a lime soap base, is gold in color and is particularly suitable for low temperature applications.

The H Grease series is designed for general purpose industrial service where higher viscosity mineral oils are required.

(26) Dowicide G

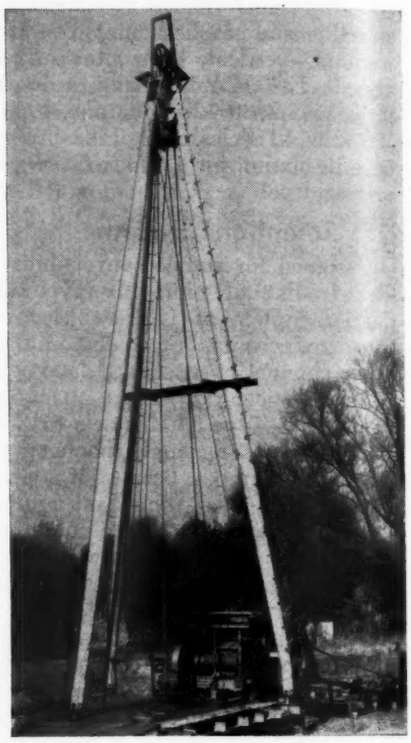
Dowicide G, water-soluble sodium pentachlorophenate, germicide and fungicide for effective control of micro-organisms in industry, is now immediately available in hard pellets comparatively free from dust according to a recent announcement by The Dow Chemical Company.

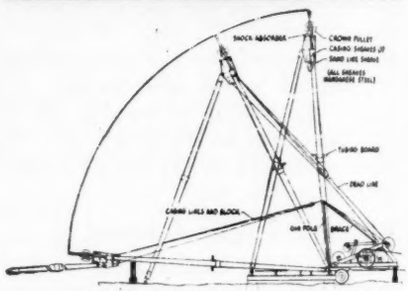
Dow engineers have developed this purely physical change from flake to pellet to control the dust and facilitate handling the salt during its application to industrial and agricultural products. The small cylindrical pellets are compressed to one-fourth the volume of the original flake.

Dowicide G has been used by industries in recent years as a germicide and fungicide, to prevent losses caused by mold and bacteria.

(27) Spudder with Steel Mast

The Young Spudder, in a skid-type frame, is mounted on a 5-in. tubular rear axle equipped with four 11.00 by 20 pneumatic tires on an 82-in. track. Air brakes are provided. If desired, the wheels can be removed for transporting the Spudder on a Carryall,



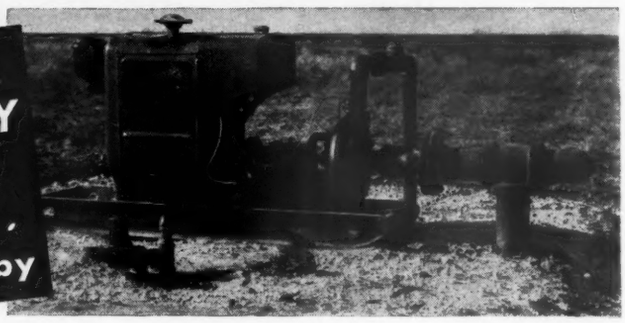


METHOD OF ERECTING SELF-SUSTAINING TRIPOD MAST

and, when necessary, axle may also be removed for skidding the Spudder into place with a tractor. Increased drilling depth is claimed for the improved Spudder. It can be driven by any gas or diesel drilling engine of sufficient power for the desired well depth.

The Young Tubular Steel Mast is of the self-sustaining tripod type. It consists of three boom type legs which are anchored to the structural steel base and require no guy lines. It is emphasized by the manufacturer that there are no girts, braces, or guy lines to interfere with pulling in the stem, casing or tubing. The line drawing shows the Young Tripod Mast assembly on the ground, ready to be raised. The weight of the mast with its structural steel base is approximately 18,000 lb, with a capacity of 250,000 lb.

POWER CERTAINTY *Where it Counts...* delivered by



WISCONSIN HEAVY DUTY *Air-Cooled* ENGINE

In a territory where mesquite is scarce and personnel is scarcer, this Model TF (11 H.P.) Wisconsin Heavy-Duty Air-Cooled 2-cylinder Power Unit is directly connected to a centrifugal pump and when its daily duty is completed, automatically shuts down. It pumps crude oil at the rate of 4,000 barrels per day so satisfactorily that this major pipe line company has already purchased fifty-six of these very same units, built by the Harley Sales Company of Tulsa and Houston.

This is the same *power certainty* that is built into all Wisconsin Air-Cooled Engines . . . 4-cycle, single-cylinder, 2-cylinder, and V-type 4-cylinder models, 2 to 30 hp.

You can't go wrong when you specify "Wisconsin Power."

WISCONSINS — PREFERRED POWER IN ALL FIELDS, 2 TO 30 HP!

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

(28) Percolation Clay

Attapulgus Clay Company, offers the petroleum industry a new granular high-efficiency fullers earth for percolation filter house use. Refining efficiency of the new clay—designated as Attapulgus AAA grade clay—has been established in extensive tests.

Claimed for "AAA" is its ability to reduce clay costs since, with most oils, it displays 10 per cent to 20 per cent more refining efficiency and maintains this increase over its life. It thereby becomes practical to reuse it through more cycles; thus clay costs are cut 15 to 25 per cent.

In addition, states the company, substantial operating credits accrue from the higher yields per ton for "AAA." They occur in such factors as filter turnovers, clay burned, oil and naphtha losses, steaming costs, upkeep on burner equipment, etc.—amounting to two to three times the reduction in clay costs.

(29) Turning Roll

Preliminary design of a new turning roll, known as Model 75, equipped with rubber tired rollers, has been completed and the first production model is undergoing routine tests at Worthington Pump and Machinery Corporation's Dunellen Works (formerly Ransome Machinery Company). Worthington-Ransome engineers have designed this 75-ton unit for heavy duty service in response to constant demand from the field for a turning roll which handles massive pieces with ease and trouble-free operation.

(30) Feed-Water Control

A new principle of boiler feedwater control uses the weight of water as a force to motivate the feed-water valve. Since no heat is required to operate it, temperature has no effect on its performance. Control is so super-sensitive that a drop of as little as ⅛-in. in the boiler will actuate the valve. Known as the "Weight-O-Water," this boiler feed-water controller designed by the J. A. Campbell Company, Long Beach, California, embodies the use of an elypsoidal balance chamber, a code vessel which is hung on a precisely engineered spring to permit its rising and lowering. Perfect equalization of levels between the chamber and boiler is provided. The up and down movement of the chamber actuates a super-sensitive control valve which requires a force of less than ½ lb to actuate. The extreme sensitivity of the valve is afforded by the elimination of any stuffing gland and the substitution of an 8-in. Neoprene stem seal. Fins on bonnet extension of valve dissipate heat and give the seal a long life.

(31) Heat Exchanger

National Carbon Company's "Karbate" impervious graphite heat exchanger, Style FH, size 1½, is recommended for heating or cooling corrosive fluids, particularly in tanks with liquid depths up to 16-in. It is designed for horizontal operation and consists of two "Karbate" impervious graphite tubes of 1½-in. I.D. by 2-in. O.D. in a parallel flow bank between "Karbate" headers.

"Karbate" brand impervious graphite has the well-known properties of high thermal conductivity and resistance to the action of most acids, alkalis and other corrosive, solvent or reducing agents, and particularly to all concentrations of hydrochloric acid and nearly all concentrations of hot sulphuric, phosphoric and acetic acids, wet chlorine and the organic solvents.

(32) Boiler Feed Pumps

Worthington Pump and Machinery Corporation announces the addition of four new boiler feed pump sizes to their line of centrifugal pumps. Two of the new sizes are six-in. pumps and two are eight-in. pumps, which add to the range of possible applications for this type of service.

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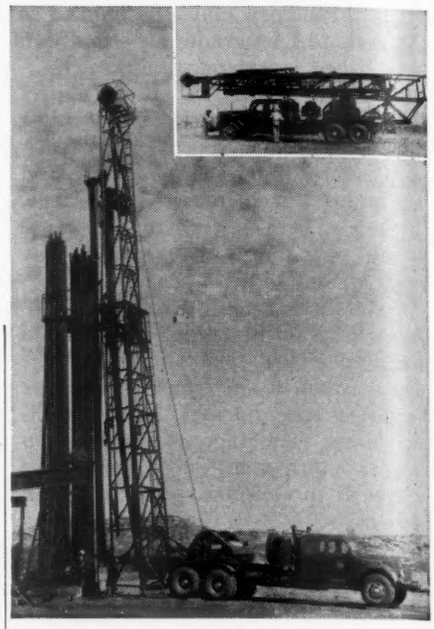
(33) "A Roustabout's Dream"

Recently developed by the Franks Manufacturing Corporation of Tulsa, Oklahoma, is an improved truck-mounted, truck motor-driven, well servicing unit complete with integrally mounted 64-ft—60,000-lb screw raised telescoping derrick. This derrick is raised from over-the-road position by two large raising screws in from four to seven minutes. Derrick extension is accomplished by a small winch located beneath the truck bed.

Using one of Franks Model 44TD truck mounted, truck motor driven telescopers as the nucleus, the following time, labor and money saving features have been added: 1. Franks Telemech, a remote and easily movable master control box that can be placed anywhere within a 25-ft radius of the unit, giving finger-tip control to the drum clutches, air brake, accelerator, starter button and ignition lock; 2. An air operated tubing board which is folded and unfolded from the derrick by an air valve controlled from the ground. The rated capacity of the board is 5000 ft of 2⅞-in. tubing in singles; 3. A new simplified means of quick and effortless leveling of the derrick is made by installing ratchet type support legs on both truck supports and front derrick legs; 4. A new winch air brake system which is spring loaded for engagement at all times until disengaged by two heavy duty air cylinders; 5. An independently driven air compressor unit is mounted behind the cab to operate air driven rod and tubing tongs; 6. Complete unit guying is accomplished by two guys.



(34) Lube Additives

An extensive line of lubricating oil additives is now manufactured and sold by Oronite Chemical Company, Standard Oil Company of California subsidiary.

The additives will be available as finished concentrates, ready for blending with base stocks to produce high grade diesel and motor lubricants in accordance with customer requirements. They will also be available as individual chemical compounds for use as lubricating oil detergents, antioxidants and corrosion inhibitors.

(35) Economical Valve

A design for cast steel valves has been developed by the research laboratories at Edward Valves, Inc., East Chicago, Indiana, that makes it possible to economize by installing a size smaller valve in pipe lines. Stop and non-return valves in either the globe or angle design use the new body for all sizes 6-in. and above in 900, 1500, and 2500 lb classes.

In some sizes the new design reduces the weight of valves to less than 50 per cent of the weight of old designs. Weight is reduced by elimination of all unnecessarily thick parts of the body making an even distribution of metal in the body walls.

(36) Way Lubricant

A product designed specifically for the lubrication of industrial tableways has been developed by the Beacon Laboratories of The Texas Company. An important addition to the cutting tool industry's lubricant needs, the new product enables Texaco now to supply a complete lubricant service for all machine tool work.

To be called Way Lubricant D, the new product is designed for use on all kinds of ways—hardened steel, chilled cast iron or the new laminates. Compounded with special additives, the product will not squeeze or press out, either when the machine is in motion, or standing still. Thus, the oil film on the way remains constant and desired precision may be maintained. It is non-corrosive to steel and copper and will not plug filters. It possesses low static and running coefficients of friction and the required tackiness.

(37) Magnetic Strain Gauge

The magnetic strain gauge, which provides a simple method of directly measuring small distortions in a static member resulting from a tensive or compressive load is announced by Westinghouse Electric Corporation.

It is particularly useful as a warning to the operator when a crane is in danger of upsetting due to overloading, or on other metal structures where variations in load may approach safe limits of the supporting member.

The unit consists of the strain gauge enclosed in a water-tight case and pilot bar sensitive to a force as small as 20 lb.

Operation is from a single phase, 110 volt, 60 cycle supply. Voltage and frequency variations should not exceed plus or minus 3 per cent. Power required is 35 volt amp.

(38) Temperature Controller

A low-cost combination motorized-valve temperature controller that makes possible more efficient and lower-cost maintenance for hundreds of industrial processes is being introduced by Minneapolis-Honeywell Regulator Company.

The new device is a temperature controller and motorized valve combination for on-off, two-position, floating or proportional control. It is said to provide speedier and more economical installation as well as improve maintenance.

In operation a remote-bulb thermal system positions a powerful motorized valve in response to temperature changes. The unit is available with temperature ranges between minus 50 deg. and plus 700 deg, and with different sizes and types of valves.

(39) Rotaries

Rugged construction and advanced design of the Brewster OB-12 Oilbath Rotaries make possible exceptional efficiency and economy in shallow drilling and deep well servicing. Designed and manufactured by The Brewster Company of Shreveport, Louisiana, the OB-12 rotary is available in a short shaft and a long shaft model. Both have a full 12 in. table opening, and can drill to 3000 ft.

Built to be as short and compact as possible, the OB-12-S model has a distance of only 29 in. from center line of table to center line of sprocket. The the OB-12 rotary model has an extended pinion shaft with a dimension of 44 in., center to center.

The rotary table is supported by a large angular contact ball bearing operating in an oilbath. No bearing adjustments are required, since the table bearing automatically seats itself according to the load. Three separted oil reservoirs provide positive, continuous lubrication.

The Brewster OB-12-S rotary weighs approximately 2100 pounds; the OB-12-L weighs approximately 2650 pounds. Rated dead load capacity for both models at O R.P.M. is 100 tons.

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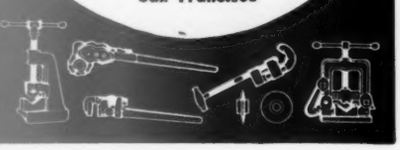


(40) Heat Exchanger

Recently announced is National Carbon Company's "Karbate" seven-tube impervious graphite shell and tube heat exchanger, Series 70A, as a redesign of the previous Series 70, thus augmenting the usefulness of this exchanger. The basic elements of the new unit may be converted from a single pass to a double pass unit by a simple change of covers. The exchanger can better be adjusted to varying rates of flow and amounts of liquid handled.

Replacement of tubes may now be made quickly and easily in the field, thus eliminating the necessity of blocking off tubes and thereby reducing capacity. Two sizes, having effective outside tube areas of 16.4 sq ft and 24.6 sq ft are carried.

(41) Electronic Bit Control

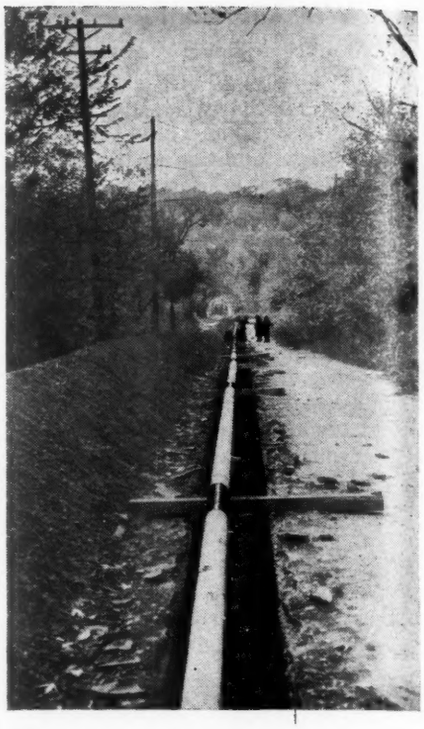
An automatic electronic control that provides exact weight for a drill bit as it penetrates oil-bearing formations thousands of feet below the earth's surface is announced by Brown Instruments Division of Minneapolis-Honeywell Regulator Company.

The control arrangement was developed cooperatively by companies in the oil and refining industries, drilling equipment makers, and industrial instrument engineers. The system makes use of a strain gauge assembly, a Brown electronic potentiometer which operates as a weight indicator on the drilling bit, and a pneumatic brake which maintains the desired weight. The brakes feed the drilling line at a rate which assures a constant and predetermined weight on the bit through all types of sub-surface formations, it was said. Early tests of the new automatic control are reported to have resulted in faster and more efficient drilling while eliminating manually controlled equipment losses and too little or too much weight on the drill bit.

(42) Starting Fluid

Wide-spread use of Diesel and gasoline powered equipment in cold climates has increased the need for a safe and economical means of starting these engines at extremely low temperatures. By use of a special patented quick-starting device, the California Oil Company states that cold weather starting difficulties with Diesel and gasoline powered engines have been overcome.

The capsules are used with a special puncturing tool and priming system, injecting the fluid into the intake manifold. The fluid flows at 70 deg below zero. Additives in the starting fluid lubricate as the engine is started. The fluid will not corrode metal parts.



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(43) Wire Rope

Jones and Laughlin Steel Corporation announces publication of a new pocket-sized handbook titled "Wire Rope Is a Machine." Interestingly illustrated, the handbook gives simple and straightforward explanation of how wire rope works, how it should be operated, and how to select and order correct wire rope construction for long service life on the job.

To demonstrate the facts of life about wire rope, small characters representing animated pieces of wire rope are used in the illustrations.

This animation carries through five sections in the handbook busily demonstrating important features of (1) installing and operating wire rope; (2) selecting the correct wire rope for the job; (3) catalog of standard J&L wire rope construction; (4) standard fittings, slings, and splicing service available with J&L wire rope; and (5) general recommendations for ropes in use on standard equipment.

Included in the catalog section are tables of weights and strengths. Vital statistics on rope end attachments are included in the section on standard fittings, slings, and splicing service.

(44) Equipment Catalog

Black, Sivalls & Bryson, Inc. announces their condensed general catalog. Listed in this attractive booklet are separators, treaters, heaters, tank, loading racks, feeders, valves and meters. Other BS&B products are given. Construction specifications, and capacities are included for each piece of equipment.

(45) Evaporators

A recent issue of G-R News, a periodical bulletin of The Griscom-Russell Co., is of particular interest as a historical survey of evaporators for the distillation of water. The bulletin traces the development of evaporators from early recorded mention of them in the diaries of voyages and the experiments of scientists, down to their present wide use in central power generating stations, industrial plants and on shipboard. A series of illustrations parallels the history, showing first a drawing of an elementary type of evaporator and continuing through the successive improvements in evaporator design.

(46) Snatch Blocks

A 16-page snatch block bulletin titled "Better Snatch Blocks for Every Purpose" has been announced. This colorful bulletin illustrates the McKissick Products Corporation's full line of snatch blocks and describes the characteristics of each block.

(47) Rigs and Hoists

Just off the press, the new Ideco Rambler Rig and Hydrair Hoist bulletin covers Ideco Hydrair Hoists, truck and trailer models of Rambler drilling and servicing rigs, Kwik-Lift masts, Hy-Lift rams, mud pumps and allied equipment. The bulletin is liberally illustrated with drawings and photographs accompanied by performance data and specifications. Additional information contained in the bulletin deals with hydraulic torque converters, air clutches and controls.

(48) Line Casing

A booklet on Spang extreme line casing has been published. A division of The National Supply Company, Spang-Chalfant has developed a type of casing which is able to combat the extremely severe and variable conditions encountered at record depths. It is illustrated with photographs and pictures, and supplemented by charts.

(49) Centrifugal Pump

Information about the pumps that combine the efficiencies of centrifugal action with positive self-priming and self-purging action is presented by Marlow Pumps in a brochure.

Attractively prepared on twelve pages and in two colors, the bulletin presents important calculation tables specially compiled by Marlow Pumps in its research and development work. They include a table of viscosities for different petroleum products with the viscosities shown at various temperatures from 40 to 100 deg, a table giving the head equivalents of various liquids and another of maximum practical suction lifts at various temperatures and from sea level to 2500 ft altitude.

(50) Oil Field Catalog

Whitney Oil Field Catalog RO-49 has been recently published. it is a completely new catalog which has been designed to supply manufacturers and users of oil field machinery with pertinent data and complete specifications on Whitney American Standard oil field assembly chains.

(51) pH and Conductivity

Brown Instrument Company, division of Minneapolis-Honeywell Regulator Company, has published a catalog on pH recorders and controllers. Automatic pH control is valuable to nearly every industrial process involving any phase of chemistry. Conductivity measurement is a means for estimating concentration of inorganic material in water solution.

(52) Production Story

The interesting story of the prodction of oil—from the first survey to the refined product—is told in the petroleum issue of *Production Road*, magazine of the Twin Disc Clutch Company, Racine, Wisconsin.

Just off the press, this 28-page pictorial review of the oil industry contains sections devoted to the exploration, drilling, pumping, piping and refining of oil. It tells the complete story of oil and the part played by Twin Disc Clutches and Hydraulic Drives in its production.

(53) Surfacing Material

The Dampney Company of America has announced availability of their bulletin 1530 describing Apexior Number 1, the protective surfacing material for boilers and for power and processing equipment in similar wet-heat service.

(54) Four Crawler Tractors

In a series of mailing folders, the industrial power division of International Harvester Company presents design and performance details on four International Diesel crawler tractors.

The folders describe the International TD-18 of 80.5 drawbar hp (Form A-93-LL), the 57-hp TD-14 (A-92-LL), and the TD-9 (A-207-11) and TD-6 (A-206-LL) models of 39 and 29.5 drawbar hp respectively.

Profitable work applications of each are spotlighted in job shot illustrations. Sectional views of the tractors reveal engineering construction details developed to increase operational economy and efficiency.

(55) Unions

Clayton Mark and Company's new catalog lists the latest specifications on all items of the Union division. Forged steel unions for refining, transportation and for oil production are manufactured by the company.

(56) Diesel D2 Tractor

Caterpillar Tractor Company has produced a new publication, Caterpillar Diesel D2 Tractor, to present the design features and range of applications of the company's 32-hp track-type tractor.

(57) Teeth

A teeth release comes from H & L Tooth Co., Montebello, California, entitled "Teeth That Really Dig." This, in the form of a color pamphlet, illustrates the character and purpose of Jeep-A-Trench teeth, made from the best grade of forged alloy steel. Inherently tough and resistant to breakage, they are further heat treated to the proper degree of hardness to insure maximum resistance to wear under the most abrasive conditions. Digger bars with points are mounted on the chain so as to have ample support on both sides, and are spaced to equalize the pull on the chain. Bars are made for trench widths from 4 in. to 21 in. The 14 in. set can be adjusted to dig 12 or 16-in. widths by changing the wide bars.

(58) Refractories

The folder, "2 New Johns-Manville Refractories for Service to 3000 F" presents pertinent information on 3X Blazecrete (for gunning and patching) and 3X Firecrete (for casting special shapes). It covers recommended uses and technical data such as cold compressive strength, modulus of rupture, per cent linear change, and yield per lb.

(59) Electric Hoists

The Wright Hoist Division of American Chain and Cable Company, Inc., of York, Pennsylvania, has just released folder, DH-65, which describes their new advanced design line of Wright Speedway electric hoists.

This attractive six page folder introduces the Speedway ½ ton to 10 ton electric hoists. It includes such information as information on Wright Speedway electric hoists, action photographs, illustrations of each type of hoist, cross sectional view of the hoist frame and complete specifications.

(60) Permanent Magnets

A 28-page illustrated catalog describing stocked G-E permanent magnets has been issued by the General Electric Company's chemical department. A wide variety of cast and sintered Alnico magnets are listed.

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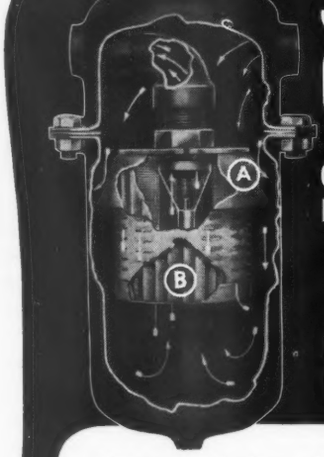

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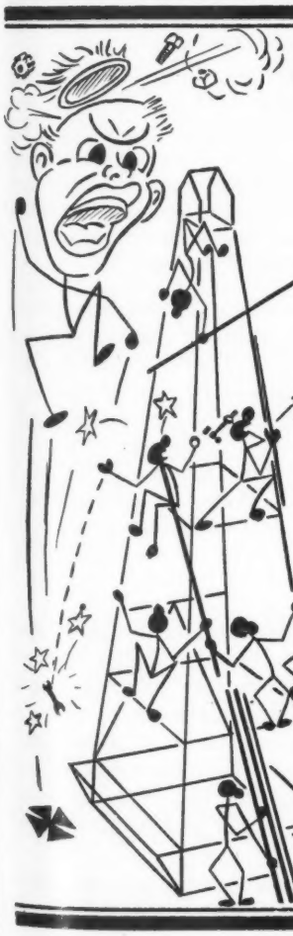

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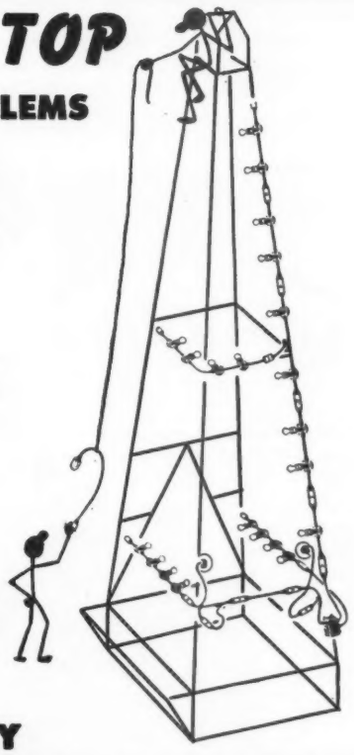

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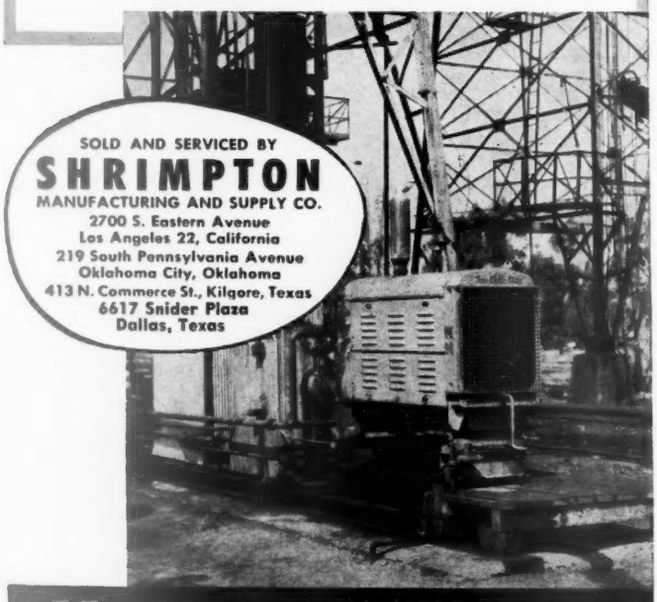

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▸ **Oil Shales and Shale Oils,** *by H. S. Bell. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York. Pages, 157. Price, $4.*

The existing information on the methods and economies of producing oil for shale is presented in this book. Oil shale sources of the world are discussed, and, in some instances, e.g., Estonia, hard-to-find data, fast becoming obscured by the Iron Curtain, are given. Mining methods, retorting and refining of oil from shale are explained. Relative costs of this oil source are tabulated.

▸ **Texas Gulf Coast Oil, 1948,** *by Frank J. Gardner. Rinehart Oil News Company, P. O. Box 1208, Dallas, Texas. Pages, 311. Price, $25, subscribers; $35, non-subscribers.*

The Texas Gulf Coast in this book covers 29 counties of the area. Each field is briefly and completely summarized for reader convenience. Part 2 is a brief tabulated history of oil development on the coast, from 1543 through 1948, while part 3 shows conditions today. Refineries, recycling plants, natural gasoline plants, repressuring plants, carbon black plants, and pipe line companies of the area are listed in part 4. A complete list of oil an dgas fields with maps and detailed information complete the survey.

▸ **Manual for Process Engineering Calculations,** *by Loyal Clarke. McGraw-Hill Company, Inc., 330 East 42nd Street, New York 18. Pages, 438. Price, $6.*

This book is intended for chemical engineers and others who need to present quick answers without adequate time for recourse to reference books. It is not a substitute for more comprehensive texts. A partial list of subjects covered in this volume includes: Numerical and mathematical data, conversion tables, physical and mechanical properties, thermodynamic data, hydraulics and flow measurements, heat transfer, combustion, power, and pumps.

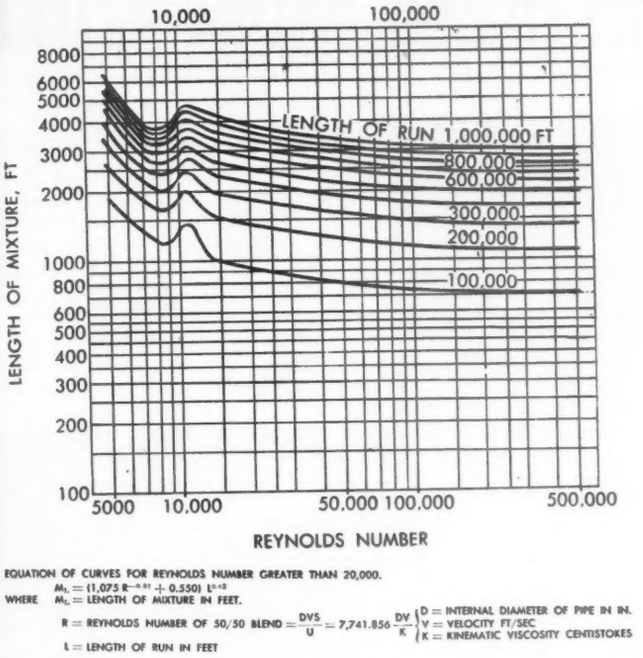
▸ **Eleventh Technical Conference on Petroleum Production,** *Mineral Industries Experiment Station Bulletin No. 48, State College, Pennsylvania. Pages, 124. Price, $2.* petroleum industry representatives and the staff of the Pennsylvania Mineral Industries Experiment Station are published in this bulletin. Subjects included "Selective Plugging with Smoke," "Relative Permeability Studies," "Effect of Water Injection in Gas Drive," "Water Flood Spacing," and three progress reports on an expanded program seeking a better delineation of the edge of the oil fields in the state and a better understanding of the reservoir rock.

▸ **ASTM Standards on Petroleum Products and Lubricants, 1948,** *American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania. Pages, 760. Price $5.50, paper cover; $6.15, cloth cover.*

This 1948 edition is the most extensive special compilation the Society has ever issued. All tests methods and standards developed by the committee have been included with the exception of those pertaining to knock rating of engine fuels.

There are more than 145 standards covering crude petroleum and a wide range of products. Several appendices and proposed methods are also included.

INTERFACIAL MIXING CHARACTERISTICS



EQUATION OF CURVES FOR REYNOLDS NUMBER GREATER THAN 20,000.

$M_L = (1{,}075\ R^{-0.31} + 0.550)\ L^{0.42}$

WHERE M_L = LENGTH OF MIXTURE IN FEET.

R = REYNOLDS NUMBER OF 50/50 BLEND $= \frac{DVS}{U} = 7{,}741.856 \frac{DV}{K}$ { D = INTERNAL DIAMETER OF PIPE IN IN. V = VELOCITY FT/SEC K = KINEMATIC VISCOSITY CENTISTOKES

L = LENGTH OF RUN IN FEET

FIG. 12. Graph of mixture distances of 100,000 ft of run vs Reynolds number of 50/50 product blends.

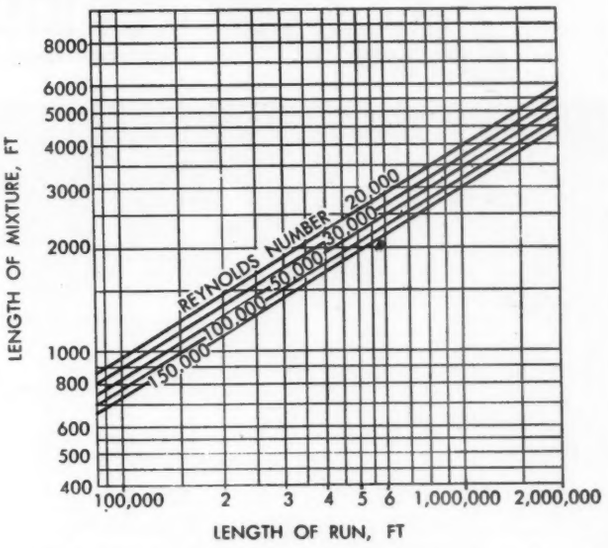


FIG. 13. Graph of mixture versus length of run, related to Reynolds numbers of 50/50 product blends

In the use of various yardsticks, we found good agreement in the pilot plant results when we used the Reynolds Number of the 50/50 mix actually determined from laboratory checks of viscosity against length (not length/diameter ratio) of mixture. When the data were used in the field we found some considerable spottiness, but by this time we were well convinced of the accuracy of our pilot plant data and the inaccuracy of our field data. Therefore, we made some special field checks in which we provided the necessary automatic sample determinations by continuous gravitometer to provide commensurate accuracy to that we had in the pilot plant. As the data derived from these special checks gave excellent agreement with pilot plant, we at this point pursued the subject far enough to demonstrate that the accuracy of results from spot sampling in the field leaves much to be desired from the standpoint of accuracy. We found that samples taken at one-minute intervals did not give the data that our continuous recording units gave, but since the latter gave regularly reproducible data while the former did not, we finally trusted only the gravitometer methods.

As we accumulated data we constructed cross plots of the information, and the mathematicians in our group applied such theoretical checks as they could. As a final result, we obtained several basic data sheets that seemed easily usable and accurate within engineering design limits. The first of these is Fig. 12, which relates Reynolds Numbers and feet of pipe traveled to feet of mixture in the pipe line. This chart has a familiar look because the form of the curves indicates the same peculiar characteristic at low Reynolds Numbers as does the friction curve for flow in pipe lines when transition is effected from laminar to turbulent flow. The Reynolds Numbers used in this set of curves were the Reynolds Numbers of the 50/50 mixtures of products handled and apply regardless of whether there is a wide spread between viscosities such as exists between No. 3 fuel oil and gasoline or whether there is a narrow spread as between kerosine and prime white. The length of contamination in feet is easily converted to barrels or gallons as desired, but plotted as we have done it is directly applicable to any diameter of pipe. For reasonable accuracy it is best to make actual viscosity determinations in the laboratory on the 50/50 mixture.

One point should be noted. From friction of flow data we approximately confirm in the 2-in. experimental line the same coefficient of friction curves that were published by Heltzel. It is to be noted that the critical breaks in mixing came at quite different Reynolds Number than the critical region in the friction curve. We think the explanation of this difference is the fact that average velocities required to get turbulence to the pipe wall are higher than those required to get a reduction in friction factors. This statement is equivalent to saying that the friction factor is agreeably affected when the core of the stream is in turbulent flow while there still exists an appreciably thick film of material at the wall that remains in laminar flow. But to support small interface mixtures requires velocities sufficiently high to carry turbulence up to the pipe wall. with the absolute minimum of wall film in laminar flow.

One of the encouraging things about the use of these data is that they apply even though the Reynolds Number of the heavier product indicates it to be at one that would give heavy intermixing. To us at least this was quite a surprise as we had assumed that both products' needs must be well in the turbulent flow range. These facts have been amply verified in field operations since our laboratory work was done.

The same data have been put together in another chart shown in Fig. 13. This chart shows a family of curves each at different Reynolds Numbers for the 50/50 mixture and plots distance traveled in the pipe line in feet against the feet of length of the total mixture, and because all differences are in logarithmic sequence it is quite easy to use this chart at interpolated values. It should be pointed out in summing up this work that all of our figures are from data that used 99 per cent purity of single product as the end point of the mixture. At this degree of purity the analysis of gravitometer charts is subject to some degree of error when the gravity differences between products are small. and in the use of these data in the field good agreement will only obtain if the accuracy of field sample is equal to that of the laboratory work. This is well illustrated in comparison of calculated to observed mixtures by field tests. *See Sheet 3.*

Taken from the article, "Interfacial Mixing Characteristics of Products in Products Pipe Line," by S. S. Smith and R. K. Schulze, Shell Oil Company, Inc., and printed in *The Petroleum Engineer*, October, 1948, pages 330 to 337 inclusive.

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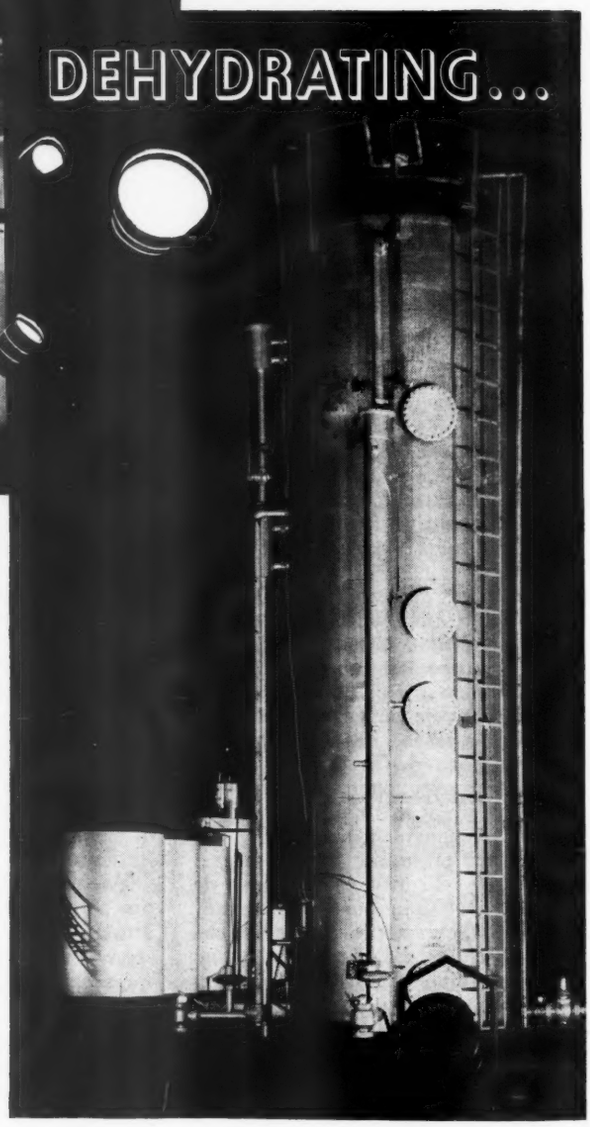

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INTERFACIAL MIXING CHARACTERISTICS

Cont'd., Sheet 2. Fig. 14 shows calculated versus observed mixtures on a 6-in. line at two points of takeoff. These data show large differences between calculated gasoline-gasoline mixtures, and observed mixtures obtained by field samples, in all cases the field data showing less mixing than indicated from our experimental data. This simply proves the impossibility of observing 1 per cent and 99 per cent purity points on an ordinary hydrometer when the gravities of the two products are nearly the same. In our own work we have practically discontinued field observation by hand-drawn samples as a result of the sort of information we have just shown you. Fig. 14 is notably interesting as showing the lower limits of velocity at which ordinary commercial lines may be operated —the lowest figures being obtained from a run at 50 bph consuming over 300 hr transit time. We have no doubt that these figures are lower than usually contemplated by operators of products lines.

Figs. 15, 16, and 17 show data on 8-in., 10-in., and 12 in. lines, and again the agreement is excellent where field data can be considered reliable. In this connection note the agreement between calculated barrels of mixture and gravitometer observed receipts of gasoline-kerosine at the end of 220 miles of run on our 8-in. line at commercial rates.

Please note that where there are large differences between calculated and observed field results, the error, if any, is on the side of conservatism and that the observations shown here, unless otherwise noted, are one-minute samples checked by ordinary field hydrometer. None of these differences invalidate the method. They only point up how far usual sampling methods and field operations fall short of absolute accuracy.

One other caution is proper in using these data on field operations. As nearly as possible the experimental line and pump stations are completely streamlined into a single tube with the absolute possible minimum of side connections and dead pockets. This is not always strictly true in the field, particularly of older lines built before some of these more critical types of operation were contemplated. By the same token, the interfaces started in these experiments were sharply cut, and there were no flying switches made across a finite time interval that could give an appreciable admixing before the products actually entered the line. Both of these factors must be given weight in using these data for design or in checking our findings against commercial line operations.

Taken from the article, "Interfacial Mixing Characteristics of Products in Products Pipe Line," by S. S. Smith and R. K. Schulze, Shell Oil Company, Inc., and printed in *The Petroleum Engineer*, October, 1948, pages 330 to 337 inclusive.

FIG. 14. 6-in. line.

L, length of run, ft	Avg. temp., F	k (from chart)	v ft/sec	$R=46{,}955\frac{V}{k}$	$(1.075\,R^{-0.87}+0.550)$	$L^{0.62}$	Mixture Calculated C_L ft	Mixture Calculated Bbl	Mixture Observed Bbl
Gasoline-gasoline									
299,060	53	0.747	0.38	23,900	0.7172	2490	1787	63.9	41.2 (45.6)*
	58	0.730	0.76	48,900	0.6393	2490	1593	57.0	(37.5)*
	63	0.710	1.12	74,000	0.6121	2490	1525	54.5	32.9 (34.1)*
	64	0.707	1.82	101,000	0.5974	2490	1489	53.2	(27.9)*
	Est. 60	0.720	3.77	246,000	0.5719	2490	1425	51.0	29
	Est. 60	0.720	3.76	245,400	0.5722	2490	1428	51.0	33
517,440	60	0.720	3.76	245,400	0.5722	3495	2000	71.6	37
Gasoline-kerosine									
299,060	Est. 60	1.231	3.75	143,000	0.5854	2490	1459	52.2	49
	Est. 60	1.231	3.75	143,000	0.5854	2490	1459	52.2	53
517,440	Est. 60	1.231	3.77	143,900	0.5852	3495	2045	73.2	66

*Mixture by color charge.

FIG. 15. 8-in. line.

L, length of run, ft	Avg. temp., F	k (from chart)	v ft/sec	$R=61{,}788\frac{V}{k}$	$(1.075\,R^{-0.87}+0.550)$	$L^{0.62}$	Mixture Calculated C_L ft	Mixture Calculated Bbl	Mixture Observed Bbl
Gasoline-gasoline									
291,298	Est. 60	0.720	4.64	398,500	0.5645	2465	1391	86.1	52
606,514	Est. 60	0.720	4.25	364,500	0.5655	3840	2172	134.3	71
895,488	Est. 60	0.720	4.15	356,000	0.5659	4920	2784	172.4	85
1,168,147	Est. 60	0.720	4.66	400,000	0.5644	5820	3285	203.5	104
1,457,808	Est. 60	0.720	4.80	412,000	0.5639	6640	3744	231.6	107
1,852,118	Est. 60	0.720	4.69	402,500	0.5643	7730	4362	270.0	105
Gasoline-kerosine									
291,298	Est. 60	1.231	4.36	218,800	0.5743	2465	1416	87.6	87
606,514	Est. 60	1.231	4.36	218,800	0.5743	3840	2205	136.7	128
895,488	Est. 60	1.231	4.36	218,800	0.5743	4920	2825	175.0	156
1,168,147	Est. 60	1.231	4.36	218,800	0.5743	5820	3342	207.0	200
1,168,147	Est. 60	1.231	4.47	224,400	0.5737	5820	3339	206.7	199*
Kerosine-fuel oil									
291,298	Est. 60	3.270	4.59	86,700	0.6046	2465	1490	92.1	57
606,514	Est. 60	3.270	4.59	86,700	0.6046	3840	2322	143.8	150
895,488	Est. 60	3.270	4.59	86,700	0.6046	4920	2975	184.1	190
1,168,147	Est. 60	3.270	4.59	86,700	0.6046	5820	3519	217.8	214

*Mixture by gravitometer.

FIG. 16. 10-in. line.

L, length of run, ft	Avg. temp, F	k (from chart)	v ft/sec	$R=77{,}420\frac{V}{k}$	$(1.075\,R^{-0.87}+0.550)$	$L^{0.62}$	Mixture Calculated C_L ft	Mixture Calculated Bbl	Mixture Observed Bbl
Gasoline-kerosine									
286,915	61.8	1.217	7.63	485,500	0.5622	2420	1362	132	200
591,730	62.0	1.214	7.63	486,000	0.5622	3800	2138	208	245
859,003	60.9	1.224	7.63	482,000	0.5623	4790	2693	262	289
1,134,250	59.6	1.235	7.75	485,500	0.5622	5690	3200	311	337
1,393,867	60.6	1.226	7.75	489,000	0.5621	6455	3633	353	360
1,650,898	55.7	1.272	4.60	280,000	0.5695	7200	4100	398	387
1,883,746	52.6	1.302	5.03	299,000	0.5686	7185	4445	432	424

FIG. 17. 12-in. line.

L, length of run, ft	Avg. temp., F	k (from chart)	v ft/sec	$R=92{,}900\frac{V}{k}$	$(1.075\,R^{-0.87}+0.550)$	$L^{0.62}$	Mixture Calculated C_L ft	Mixture Calculated Bbl	Mixture Observed Bbl
Gasoline-kerosine									
322,186	68.5	1.160	7.37	590,000	0.5603	2600	1458	204	248
661,109	65.5	1.185	7.36	576,500	0.5605	4090	2292	321	340
1,018,301	66.4	1.178	7.41	584,000	0.5601	5320	2982	417	404
1,402,896	65.1	1.189	7.57	591,000	0.5603	6490	3638	509	476
1,726,085	60.9	1.223	7.62	579,000	0.5604	7250	4060	568	544
2,033,803	61.0	1.222	7.62	579,000	0.5604	8135	4555	637	608
2,279,534	60.0	1.231	5.97	450,000	0.5630	8710	4905	686	653

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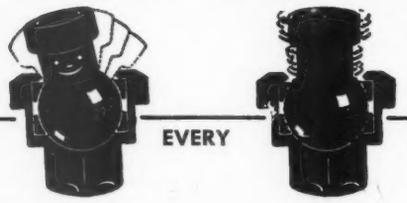


"MOVE IN EVERY DIRECTION"

ELECTRIC POWER GENERATION IN OIL FIELDS

Fig. 4 illustrates power factor circle and diagram covering the load condition discussed. OA represents kva of the load without correction. The corrective capacity is represented by AB and the resultant load is OB.

With 15 units operating, the voltage dip, on starting the 16th motor, is approximately 8 per cent. *This still provides sufficient torque to start the well and does not interfere with units in operation.*

The above information indicates that where a multiplicity of units is involved, and the *power factor is corrected to .8 lagging*, generating equipment can be installed on the basis of *1 kva per hp of connected load.*

At the other extreme, would be the condition, as illustrated in Fig. 2, where a generator would take care of one motor pumping unit. If power factor correction is not provided, it would require a generator of about 25 kva (20 kw at .8 power factor) to maintain sufficient voltage to start the loaded motor. This is equivalent to 3.3 kva per horsepower of connected load.

In most cases the range of required generator capacity will be from 1.25 kva to 1.88 kva per horsepower of connected load. *The best basis for final selection of generator equipment is the application of good judgment based on experience.* When power factor correction is not applied, the power factor will frequently be as low as .6 or even .5 lagging. A standard generator, designed for operating at .8 power factor, will not deliver full load kva under that condition.

Fig. 5 shows the kva capacity of .8 power factor generators when operated at other power factors. This may assist in the application of standard generators to low lagging power factor loads.

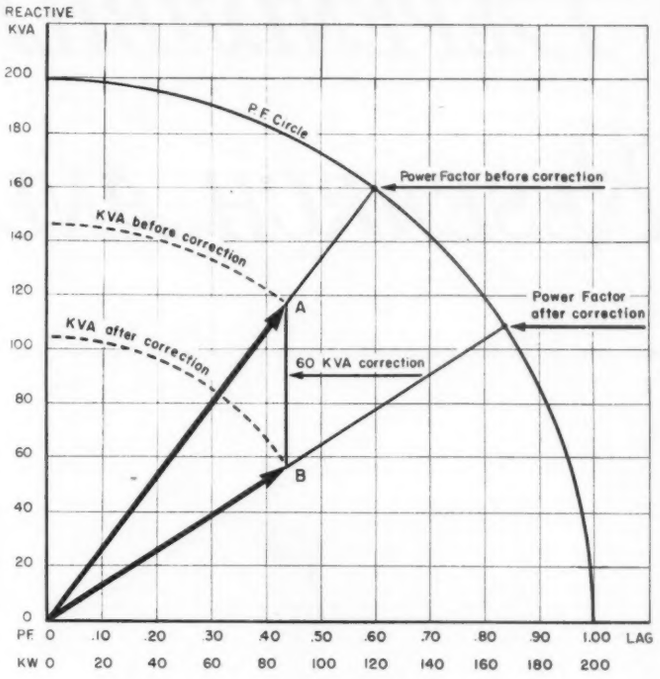


FIG. 4

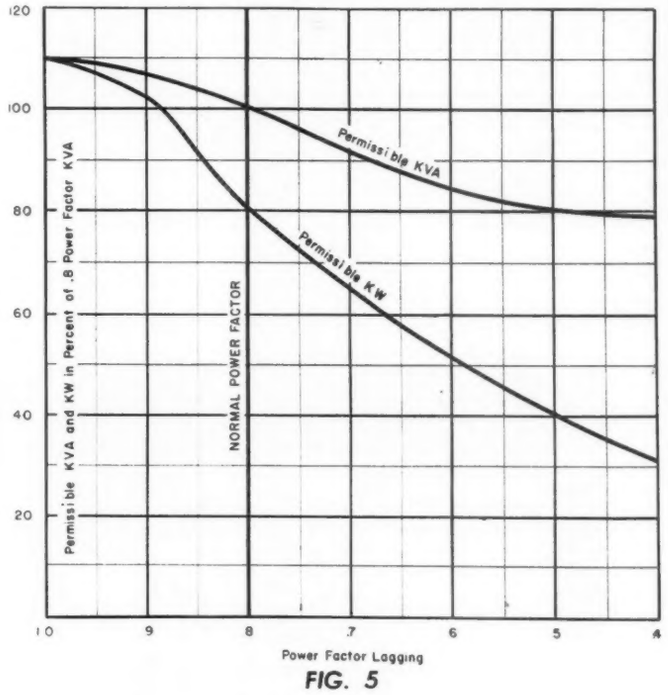
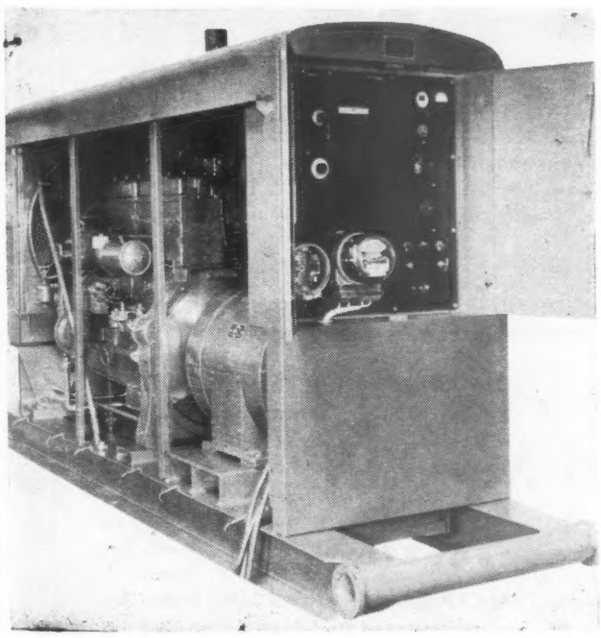


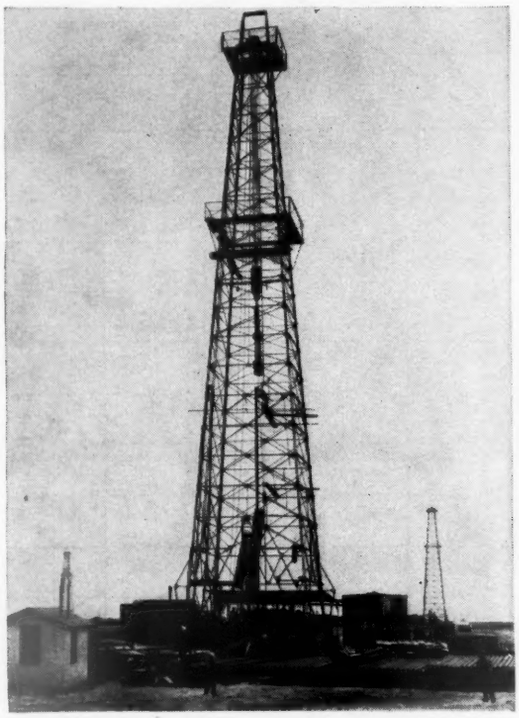
FIG. 5



An example of the portable type plant for use in oil fields. This generating unit is rated at 60-kw, 1200-rpm, 240/480-v and is equipped for gas-gasoline-butane operation.

Taken from the article "Electric Power Generation in Oil Fields," by G. L. Oscarson, Chief Application Engineer, Electric Machinery Manufacturing Company; published in *The Petroleum Engineer*, September, 1948, pages 66 to 74, inclusive.

DEPENDABILITY THROUGH RESEARCH AND ENGINEERING



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ELECTRIC POWER GENERATION IN OIL FIELDS

Power for Reda pumps. Reda pump motors are frequently used in capacities from 20 to 150 hp. They operate at 3600 rpm and have a high starting kva inrush. Since the motor is placed below fluid level in the well, it may be several thousand feet from the source of power. This necessitates a wide range of voltages being available in the generator. Quite frequently 12 generator leads are brought out, permitting connection as 1 or 2 circuit wye or delta. Available voltage are thus 480-830-960-1660.

The reactance voltage drop in the cable to the motor will be quite appreciable during the starting period. To minimize this, the engine speed is frequently cut to 50 per cent while starting the pump. The line frequency is thus 30 cycles and the reactance drop is only one-half of the 60-cycle value. A separate engine-driven exciter is provided to maintain full excitation on the generator at reduced speeds.

Since one motor is applied to one generator, the starting kva, in per cent of generator rating, is quite high. To enable the generator to deliver sufficient kva to start the motor, *field forcing* is frequently used. This merely consists in designing the field so that more than normal excitation can be applied.

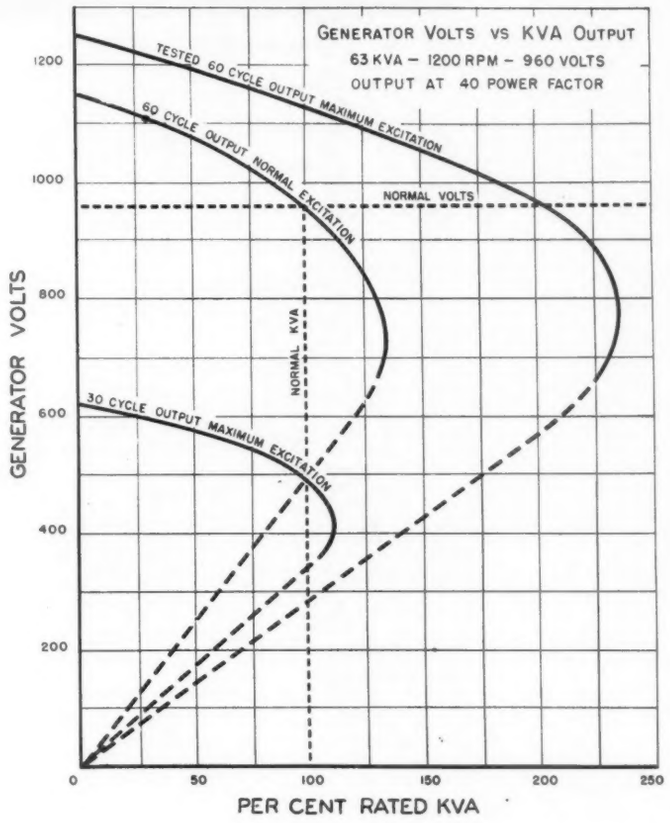
Fig. 6 illustrates the extra capacity that can be built into a generator to provide such capacity. With normal excitation, a generator might deliver 130 per cent of rated kva as a maximum value. *By designing the machine for 100 per cent field forcing it is possible to get it to deliver 230 per cent kva.*

The 30-cycle value is also shown in Fig. 6. When full field forcing is applied, it is actually possible to obtain more than the normal 60 cycles, full load rating of the generator at 30 cycles.

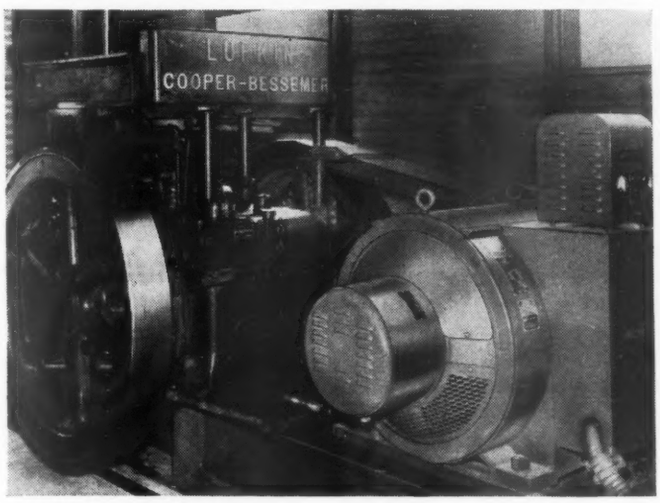
Packaged equipment. A typical packaged generator installation is shown at right. This consists of two 50 kw, engine-driven "packaged" generators. Automatic synchronizers are provided, making it possible to synchronize these units in a minimum length of time and with a minimum amount of skill being required on the part of the operator.

These units, mounted on common sub-bases with their prime movers, are used to provide power for oil field production and other petroleum industry requirements.

FIG. 6

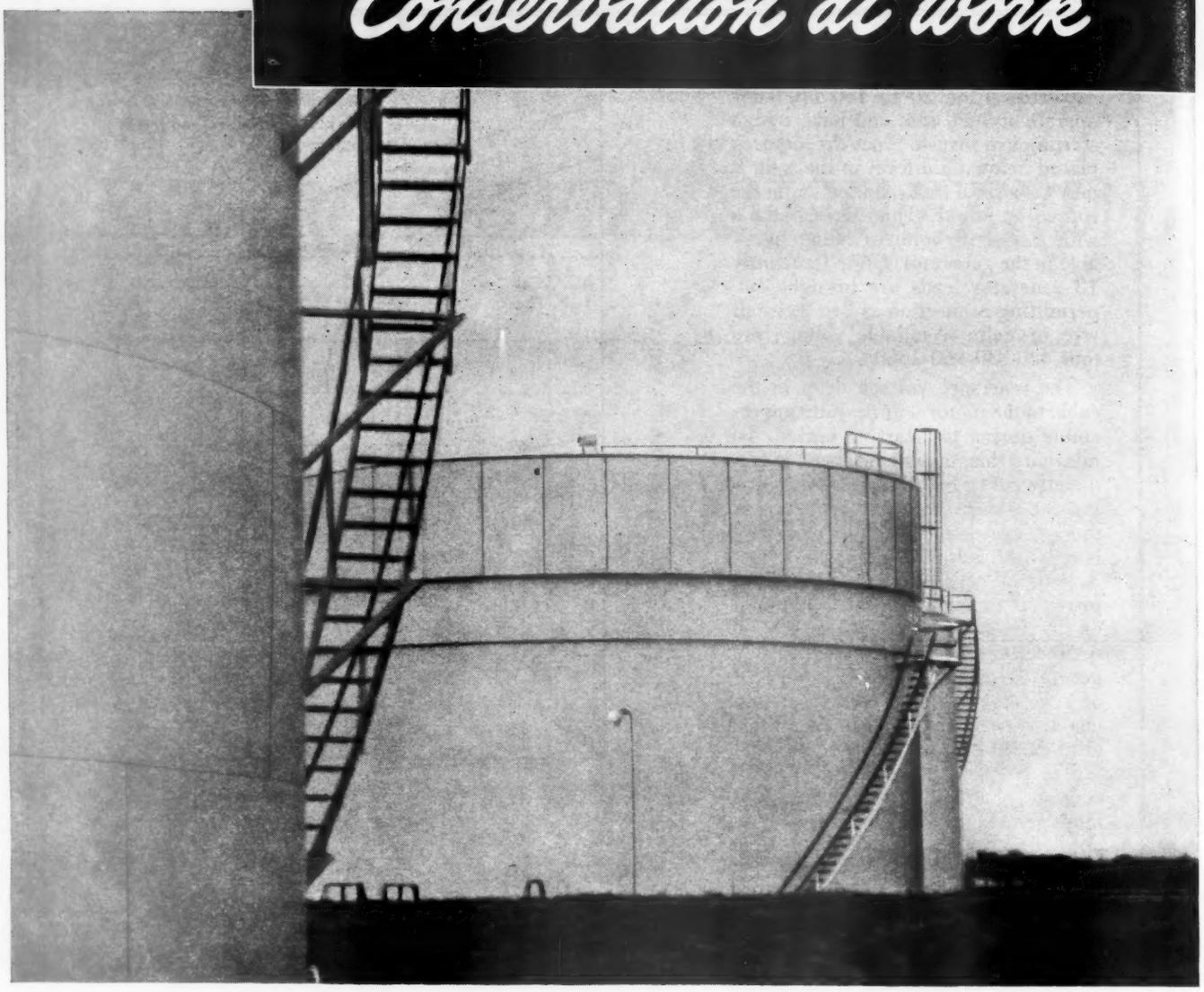


This oil well installation at Temple, Oklahoma, uses a 50-kva, 1200-rpm, 480-v packaged generator.



Taken from the article "Electric Power Generation in Oil Fields," by G. L. Oscarson, Chief Application Engineer, Electric Machinery Manufacturing Company; published in *The Petroleum Engineer*, September, 1948, pages 66 to 74, inclusive.

Conservation at work



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FACTORS AFFECTING WELL DEPTH MEASUREMENT

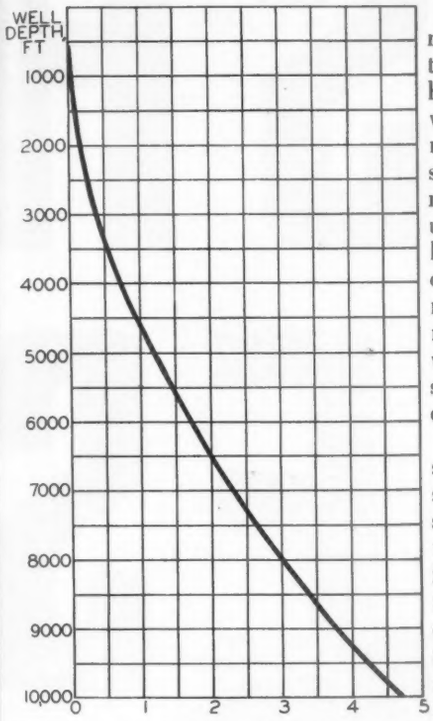


FIG. 1. Stretch of casing, tubing or drill pipe in 12 lb (per gallon) mud.

ACCURATE oil well depth measurements are of primary importance to protect the investment involved in drilling a well. The expenditure for geological and geophysical data is often of little value unless the depth of the expected producing horizon is fixed accurately below the surface. Some of the sources of measurement discrepancies are as follows:

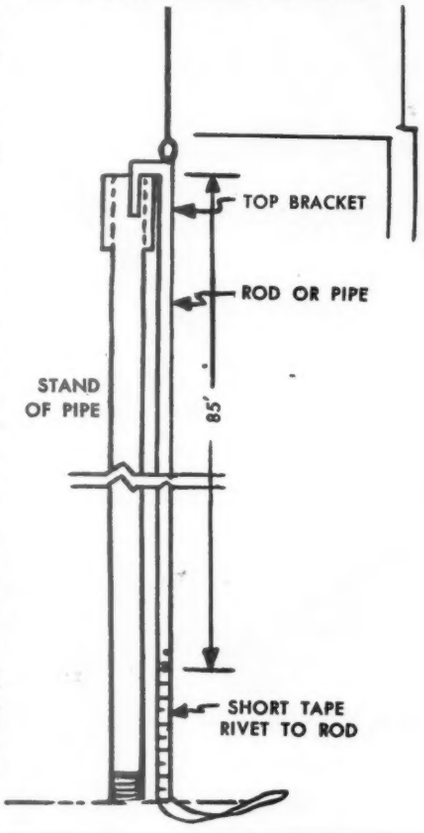
4. *Stretch of Tubular Goods.* It is universally recognized that tubular goods will stretch when a load is applied. The amount of stretch is a function of the load, or depth suspended. For example, a joint of pipe on the lower end of a string stretches very little compared to a joint of pipe at the surface with 8000 ft of pipe suspended from its bottom end. It has been determined that 8000 ft of a uniform string of casing, tubing, or drill pipe of a given size will stretch about 44 in. suspended in air, 38 in. suspended in water, and 36 in. suspended in 12-lb mud (see Fig. 1). This means that a string of pipe would stretch when lowered into the hole so that the measurement on the rack would indicate a bottom measurement less than true depth. Consequently, this stretch factor should be taken into account when correlating measurements between drill pipe, casing, and tubing "yardsticks," particularly where each yardstick has been measured under different conditions or circumstances.

It is considered the best practice to measure pipe while pulling it *out* of the hole in a *strain* (with the pipe hanging in the elevators before its weight is set in the slips). This method measures the pipe while it is in tension and no correction for stretch is necessary. Although this strain measurement is subject to error due to wind blowing the tape, this source of error can be overcome by using a measuring rod (see Fig. 2). Such a rod can be made of small pipe, or sucker rods, with a shoulder on one end and a short section of graduated tape at the lower end.

5. *Temperature.* Tubular goods are subject to changes in length as a result of changes in temperature. The same is true of measuring tapes and wire lines used by the various service companies. For commercial casing, drill pipe, and tubing the coefficient of expansion has been determined (Spang-Chalfant Handbook) as coef. $= 6.9 \times 10^{-6}$ per ° F (over a range of from 0° F to 400° F). The length of a pipe or string is

$$L_t = L_o\ (1 + .0000069 \times t); \quad (1)$$

FIG. 2. Suspended rod for measuring pipe standing in derrick.



Taken from the article, "Engineering Factors in Measuring Well Depths," by C. R. Searcy, published in *The Petroleum Engineer*, September, 1948, pages 76 to 84 inclusive.

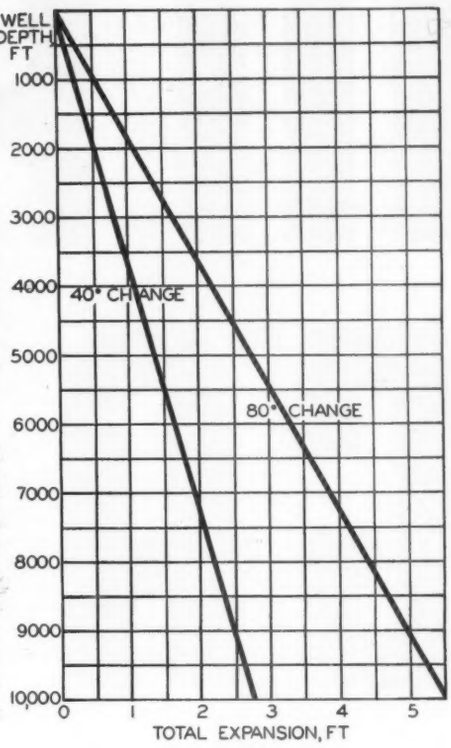


FIG. 3. Expansion of tubular goods due to temperature. Measured at surface and in well fluid.

Where:

L_o = length at temperature before heating,

L_t = length at temperature after heating,

t = change in temperature (in ° F).

For example, if a string of pipe is 8000 ft in length at 70 F and heated to a temperature of 150 F its true length would then be:

$$L_t = L_o\ (1 + .0000069 \times t),$$

Substituting:

$$L_t = 8000\ (1 + .0000069 \times 80\ F),$$

$$L_t = 8000\ (1 + .0005520),$$

$L_t = 8004.41$ ft at 150 F.

This temperature factor is further depicted in Fig. 3 for depths to 10,000 ft and temperature changes of from 40 F to 80 F. It can be seen readily that changes in length due to temperature may become appreciable at relatively shallow depths. It is common practice, however, not to correct for differences in atmospheric and down-the-hole temperature when measuring tubular goods. All surface measurements are comparable, therefore, without making the temperature correction, particularly those made coming out of the hole with the tubular goods in a strain.

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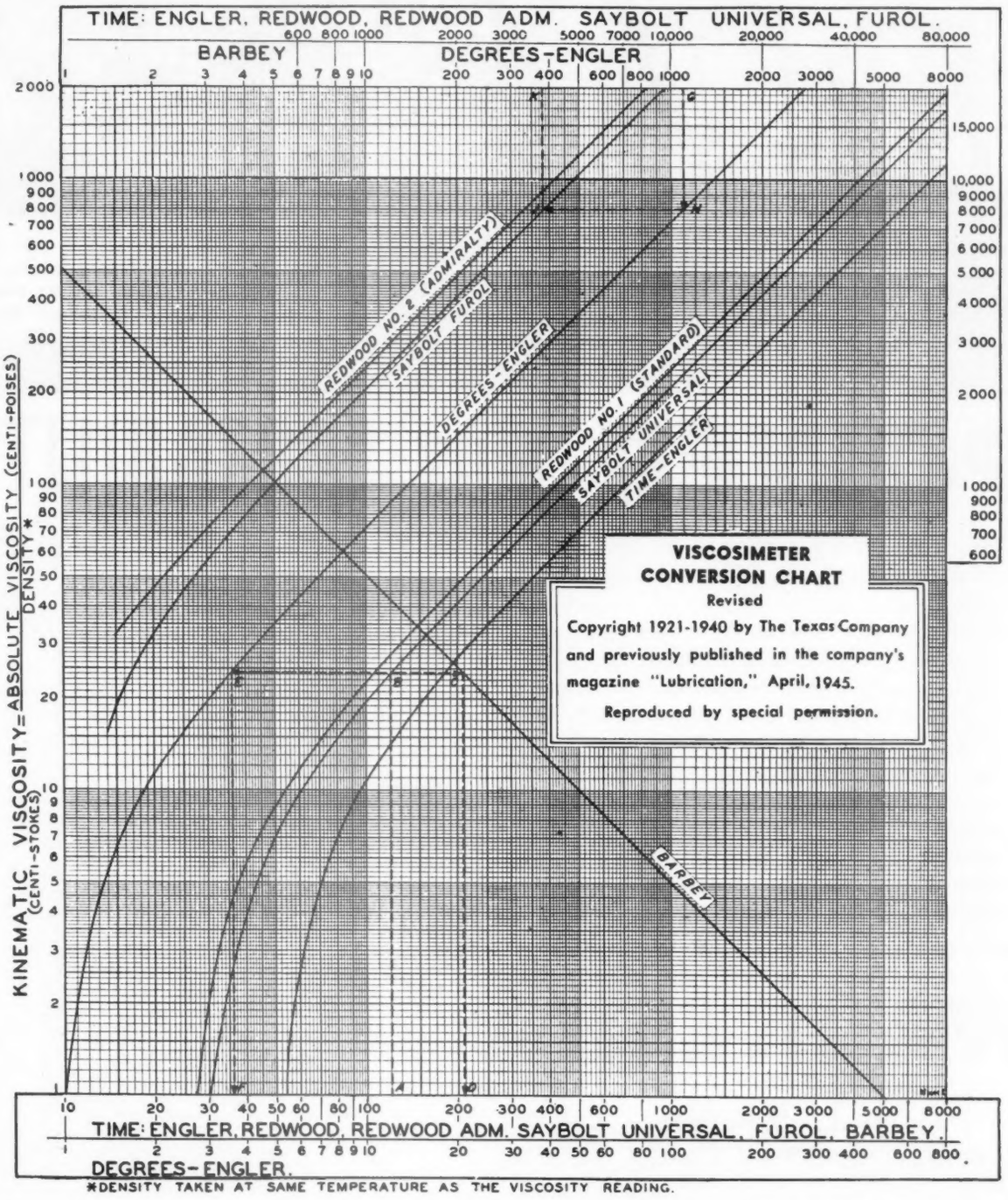
TIME: ENGLER, REDWOOD, REDWOOD ADM. SAYBOLT UNIVERSAL, FUROL.
BARBEY
DEGREES-ENGLER
KINEMATIC VISCOSITY = ABSOLUTE VISCOSITY (CENTI-POISES) / DENSITY*
(CENTI-STOKES)
REDWOOD NO. 2 (ADMIRALTY)
SAYBOLT FUROL
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TIME: ENGLER, REDWOOD, REDWOOD ADM. SAYBOLT UNIVERSAL, FUROL, BARBEY.
DEGREES-ENGLER.
*DENSITY TAKEN AT SAME TEMPERATURE AS THE VISCOSITY READING.

There are two sets of scales which must not be confused with each other. The scales at top and right-hand side go together, and apply only to very viscous products beyond the range of other scales.

The lower bottom scale applies only to Degrees-Engler. The upper bottom scale applies to all other readings, including Engler-Time.

In changing from one viscosimeter to another, scales at left and right are not used. Scales at top never used with those at bottom.

EXAMPLE: For ordinary cases.

GIVEN: Saybolt Universal Viscosity = 120".

DESIRED: Case (a) Barbey reading.
Case (b) Engler-Degree reading.

PROCEDURE: Find point on bottom scales for Saybolt Universal corresponding to 120" (A). Follow up vertically to curve marked Saybolt Universal (the known instrument) (B).

(a) To get Barbey reading: Follow horizontally to curve marked Barbey (C). Drop down to bottom scale for Barbey and read (D). Reading = 208°.

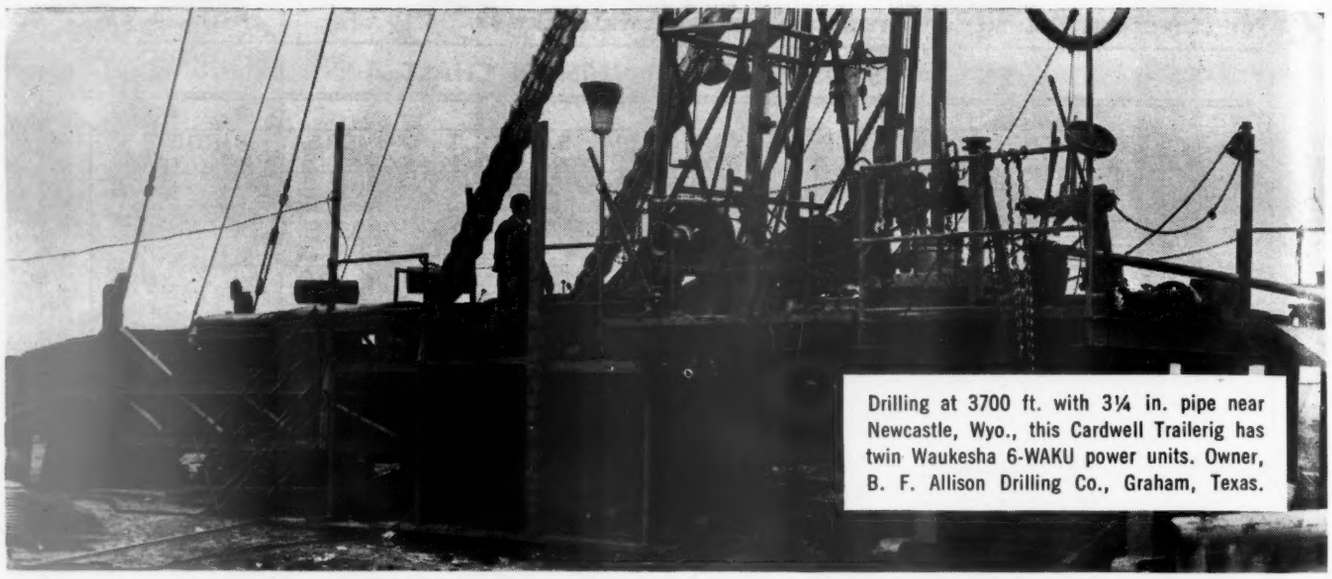
(b) To get Engler-Degree reading: Follow horizontally to curve marked Degrees-Engler (E). Drop down to lower of the two bottom scales, for Engler-Degrees and read (F). Reading = 3.60° i.e., 120" Saybolt = Barbey 208° = Engler 3.60.

EXAMPLE: For very viscous fluids.

GIVEN: Engler-Degrees = 1100°.

DESIRED: Saybolt Furol reading.

PROCEDURE: Find point on upper scales under Degrees-Engler corresponding to 1100° (G). Follow vertically down to Degrees-Engler curve (H). Follow horizontally to curve marked Furol (J). Rise vertically to scales under Furol and read (K). Reading = 3800" i.e., 1100° Engler = 3800" Furol.



Drilling at 3700 ft. with 3¼ in. pipe near Newcastle, Wyo., this Cardwell Trailerig has twin Waukesha 6-WAKU power units. Owner, B. F. Allison Drilling Co., Graham, Texas.

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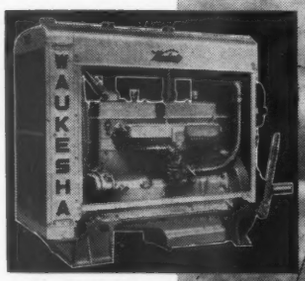
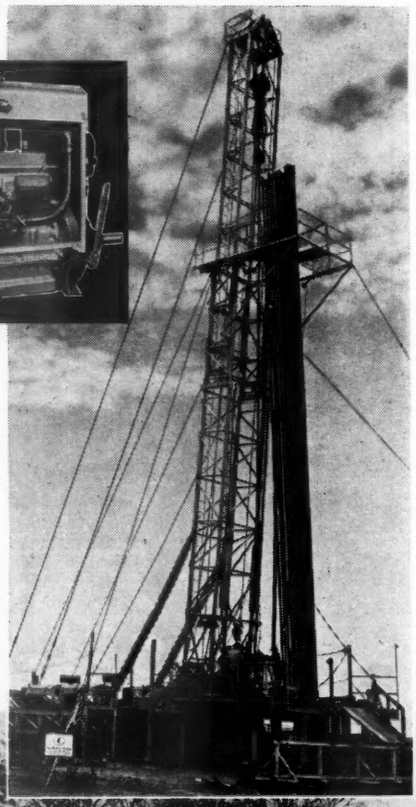
The *Cardwell* TRAILERIG is modern, complete, compact! entirely self-contained! portability plus! Recommended by its makers for drilling to 5000 ft. with 4½ in. drill pipe and workover jobs to 10,000 ft. Equipped with 90 ft. telescoping mast and mud pump drive. Double drum drawworks has twin Waukesha 6-WAKU Power Units, each one putting out better than 200 hp. at the peaks. Air disc clutches in both ends of drum provide high and low drum speeds operated by single lever. All necessary hoisting, mud pump and table speeds available simultaneously. Waukesha Super-Duty Sixes for dependable drilling. Get Bulletin 1139.



Model 6-WAKU POWER UNIT
six cyl. 6¼ in. x 6½ in., 1197 cu. in., 213 hp. max. at 1300 rpm., burns gas or gasoline.



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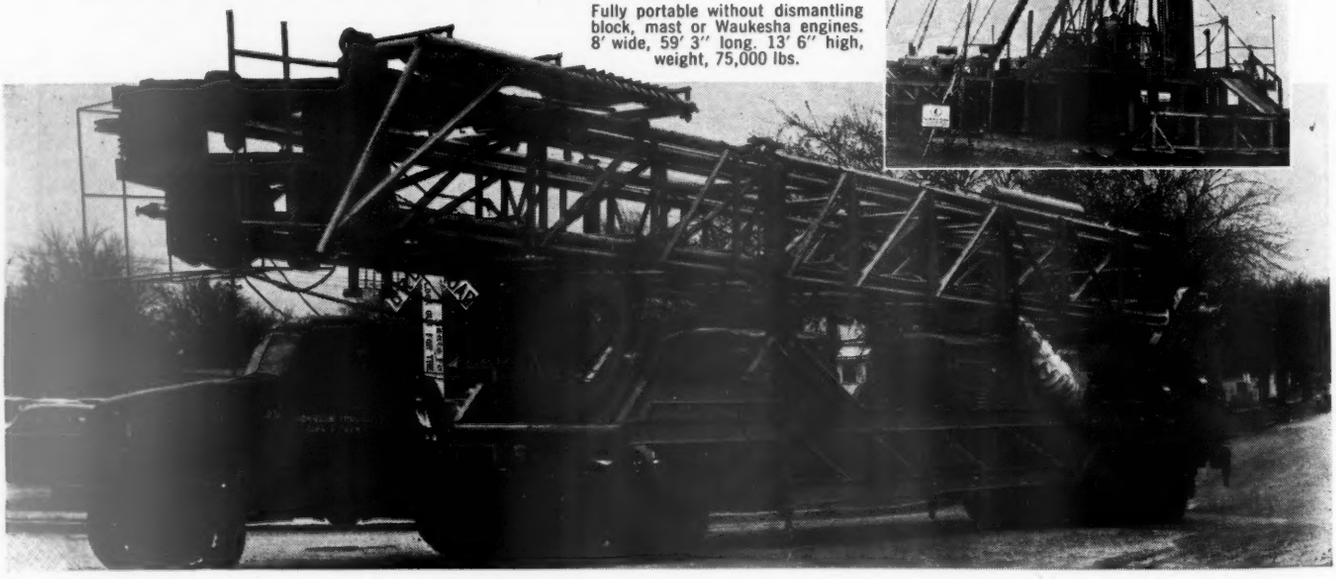


Appendixes to History and Analysis of U. S. Bureau of Mines' Petroleum and Natural Gas Division

(See Page A-43 for Part 4)

APPENDIX A

a. Petroleum and Natural Gas Division

(See Fig. 1, Part 1, for position in government organization)

Functions. The principal functions are:

To conduct engineering, chemical, and thermodynamic research on the production, transportation, and refining of petroleum, natural gas, and their derivatives, with the view of reducing waste, increasing efficiency, and developing better methods and products.

To conduct, operate, and maintain plants that supply helium; to search for, acquire rights in, develop, and conserve helium-bearing natural gas fields; to conduct research on the conservation, production, purification, and use of helium.

To supply information concerning petroleum, natural gas, and helium to Governmental agencies, industries, and the public.

Organization. The Petroleum and Natural Gas Division is composed of

1. The Petroleum Sub-Division with headquarters in Washington, which directs investigative and research activities of two experiment stations and four field offices.

2. Helium Sub-division with Washington headquarters, which supervises four plants and one laboratory in the field.

Petroleum Sub-Division

Specific Activities. The specific activities of the Petroleum Sub-Division embrace the following:

1. Research in primary extraction of crude oil and natural gas, which consists of four groups of studies: (1) Studies of petroleum reservoirs; (2) of pressures, temperatures, and volumetric relations in wells and reservoirs; (3) studies of composition of reservoir fluids, and (4) the study of corrosion of equipment in high pressure wells.

2. Research in secondary recovery and development of oil-impregnated surface and near-surface deposits. The following indicates the broad field of research: Study of past history of secondary-recovery operations; study of oil fields of the nation to disclose fields in which secondary-recovery methods may be applicable; field experimentation combined with laboratory research to test the applicability of stimulating operations in a particular field; laboratory and field tests to establish commercial methods for extracting oil from saturated surface and near-surface deposits; research to increase production rates and prevent abandonment of stripper wells.

3. The study of transportation and storage of petroleum and natural gas with a view of increasing efficiency in transportation and storage.

4. Research in chemistry and refining of petroleum. These activities consist of crude oil surveys, pilot plant operations, hydrocarbon analysis, research on fuel combustion and on sulphur compounds.

5. Research in thermodynamics of hydrocarbons. Three types of direct thermochemical measurements are made in the thermodynamic laboratory: The determination of heats of combustion of pure substances, the determination of the specific heats of hydrocarbon vapors at elevated temperatures, and the determination of the thermal properties of hydrocarbons from extremely low temperatures up to room temperatures or higher.

Field Offices. The investigative and research work of the Petroleum Sub-Division is carried out by the Petroleum Experiment Station in Bartlesville, Oklahoma, the Petroleum and Oil-Shale Experiment Station in Laramie, Wyoming, and Petroleum Field Offices in San Francisco, California, Dallas and Wichita Falls, Texas, and Franklin, Pennsylvania.

Helium Sub-Division

Specific Activities. The specific activities of the Helium Sub-Division are twofold: Research in and production of helium. As to research, the Sub-Division conducts inquiries and investigations concerning resources, production, repurification, storage, and utilization of helium. These inquiries and investigations (with the exception of research on utilization aiming at the expansion of present uses of helium) are related to natural gas with special emphasis upon the helium constituent, and they are correlated to the work previously described under the heading of Petroleum Sub-Division.

As to production of helium, the Sub-Division maintains four plants capable of processing natural gas for the removal of helium. Three of the plants are in a stand-by condition, one is in operating condition for the production of helium for both Governmental and commercial users. There are no direct appropriations for the production of helium. Production is carried out on a reimbursement basis.

Field Offices. The research functions of the Helium Sub-Division are performed by the Cryogenic Laboratory at Amarillo, Texas, while the activities pertaining to the actual production of helium are carried out by:

(a) The Administrative Office at Amarillo, Texas. The Chief Helium Engineer heads the office under the general direction of the Chief of the Petroleum and Natural Gas Division. The chief engineer is in charge of all activities at all helium plants and related natural gas properties. The facilities and rights under his supervision include four helium plants, which cost more than $10,000,000; natural gas rights in 65,000 acres of land, 13 deep wells, and more than 275 miles of pipe line; and natural gas contracts covering about 100,000 acres of land.

(b) Amarillo Helium Plant, at Amarillo, Texas, in a stand-by condition.

(c) Exell Helium Plant, at Exell, Texas, in an operating condition.

(d) Otis Helium Plant, at Otis, Kansas, in a stand-by condition.

(e) Navajo Helium Plant, near Shiprock, New Mexico, in a stand-by condition.

APPENDIX B

Cooperative Agreements

The Petroleum and Natural Gas Division is a party to the following cooperative arrangements.

Army Working Fund

Pursuant to a request from the Army Air Forces the Bureau of Mines (agreements of The Petroleum and Natural Gas Division are of course made by Bureau of Mines) formulated a program to determine the availability of crude oil and refining facilities for producing the desired fuels for military aircraft. The program has been divided into the following categories of studies: Crude oils: refinery processes; refinery products; refinery capacity; and availability.

The program submitted by the Bureau was accepted and the War Department transferred $105,175 in 1946, to bear the expenses of the program during the remainder of that year and additional funds have been made available for continuation of this work through the year 1949. The research program is carried out at the Bartlesville Station.

Navy Working Fund

During fiscal year 1947 the Bureau of Ships of the Navy Department requested the Bureau of Mines to analyze three selected Diesel fuels and provided a sum of $4,000 for the work. A detailed chemical analysis of the fuels will be completed during 1949 at the Petroleum Experiment Station in Bartlesville.

Agreement With the State of Oklahoma

The Bureau and the State of Oklahoma entered into a cooperative agreement with a view to improving conditions in the oil industry, to safeguard life among employees, to prevent waste of resources, to increase efficiency in the utilization of petroleum and natural gas.

The experiment station at Bartlesville, Oklahoma, serves as the working quarters for cooperative personnel employed by reason of this agreement. The state allocated approximately $60,000 for 1948 and another like sum for 1949.

Agreement With Arkansas Oil and Gas Commission

Under the agreement the Bureau of Mines is conducting research to obtain technical facts relating to the behavior of different types of natural petroleum reservoirs under different methods of development and operation in the Arkansas fields. The sum of $1500 was provided by the Commission for this work for the fiscal year 1949.

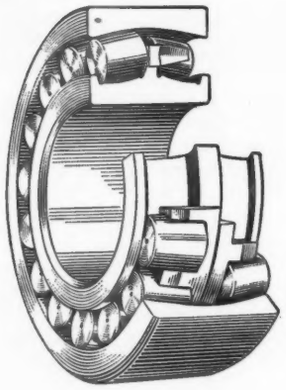
Agreement With the Kansas State Board of Health

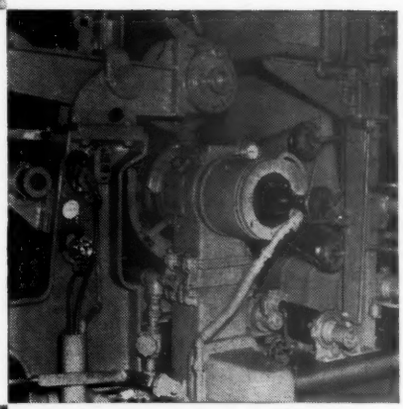
Under the agreement the Bureau agreed to supervise and conduct systematic studies of methods for the disposal of oilfield brines and for the use of such brines for secondary recovery of crude petroleum in selected areas in the State of Kansas. The State Board of Health agreed to expend funds for this investigation and make the necessary routine brine and water analyses in their labora-

Torrington Spherical Roller Bearings

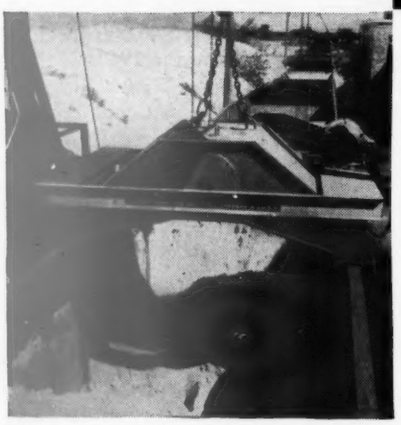
roll back costs

Emsco mounts slush pump main shaft on Torrington Spherical Roller Bearings for dependable day-in, day-out performance on the heaviest drilling schedules.





Beloit gets accurate initial and running alignment of suction press rolls with Spherical Roller Bearings. Maintenance costs go down because bearings need less attention.



Robins Car Shakeout eccentric shafts are mounted on Torrington Spherical Roller Bearings. Power requirements are negligible, thanks to the smooth operation of these self-aligning bearings.

If you measure costs in man-hours, power and production, Torrington Spherical Bearings can roll them back.

Where these self-aligning bearings operate, maintenance crews spend no time making adjustments. Proper rolling alignment is automatically maintained. Even under deflection and misalignment, the bearings run smoothly, so power input is less and service life longer. Replacements are few and far between, downtime reduced, production sustained.

Your heavy-duty machinery, too, can cost less to run and maintain with the advantages of Spherical Roller Bearing operation. Our engineers will bring to your specific friction problems specialized experience gained in every industry. Write us today.

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tories, and assist in gathering brine and water samples. No specified sum is designated. Expenditures are made by Kansas Mines vouchers upon approval by the Bureau of Mines.

Agreement With the University of Wyoming

The Bureau of Mines and the University of Wyoming entered into a cooperative agreement with the purpose of making investigations and disseminating information with a view of improving conditions in the oil and synthetic fuels industry, safeguarding life among employes, preventing waste of resources, increasing efficiency and the utilization of petroleum, natural gas, and synthetic fuels. The Bureau of Mines agreed to maintain a Petroleum and Oil Shale Experiment Station on the University campus for the purpose of making investigations as assigned to it from time to time by the Director of the Bureau.

Agreement With the Texas Technological College

The Bureau and the College entered into an agreement to cooperate in planning and conducting experiments with regard to well cuttings and core specimens, and such other experiments as may be deemed advisable in connection with these objectives.

The work under this cooperation is conducted in accordance with plans that are agreed upon from time to time by the representatives of the Bureau and designated members of the faculty of the college. The Bureau agreed to furnish such apparatus as it has on hand for use in the laboratories, and give technical supervision and advice. The college provides facilities suitable to protect the equipment supplied by the Bureau.

Agreement With the American Petroleum Institute

The Bureau and the API concluded an agreement to cooperate in planning and conducting a study for the purpose of obtaining information regarding the characteristics of gasoline sold to the public through service stations and other retail outlets. The Bureau compiles, tabulates, analyzes, and comments upon the data which the Institute furnishes. The semi-annual National Motor Gasoline Surveys are the direct result of this cooperation. The cooperative agreement was formerly with Coordinating Research Council.

Agreement With the American Petroleum Institute

In cooperation with API, the Bureau of Mines is conducting research to develop techniques for determining the fluid content of producing reservoirs with the primary objective of quantitative measurement locally of reservoir oil, gas, and water at any time during the life of the reservoir. The work has turned from the study of mechanical methods to an investigation of the use of tracers in oil-based drilling muds to accomplish the practical objectives of this research.

Agreement With Natural Gas Department of American Gas Association

The Bureau and the Association agreed to cooperate in planning and conducting an investigation into the causes of freezing of natural gas pipe lines and methods of preventing freezing. This cooperation follows the plans that are agreed upon by representatives of the Bureau and members of the Pipe Line Flow Committee, which is a subcommittee of the Technical and Research Committee of the Association. The Bureau agreed to supervise the investigation, and make needed equipment available, providing space for the work. So far $3500 has been provided by AGA and additional sums will be forthcoming in 1949 to complete the first phase of the problem.

Agreement With Natural Gas Department of American Gas Association

The agreement between the Bureau and the Association provides for cooperation in planning and conducting an investigation of methods of controlling and gauging oil and gas deliveries from high pressure combination wells in order to prevent excessive gas waste and damage to wells, and to utilize economically the energy of the gas under pressure in the reservoir.

The Bureau supervises the investigation, supplies the services of such investigators as it can assign from its force, provides working quarters in its offices and laboratories, and makes available such equipment as it possesses. The AGA has provided $24,000 to cover expenses.

Agreement With the North Texas Oil and Gas Association

Under the agreement the Bureau of Mines is conducting investigations with the view to increasing the production of oil and gas and of bringing about a more efficient extraction of petroleum from underground reservoirs by applied technical research. The sum of $3400 was provided by the North Texas Oil and Gas Association.

Agreement With the Natural Gasoline Association of America

The Bureau and the Association agreed to cooperate with a view of determining the causes of internal corrosion of well equipment and methods of preventing corrosion which is a menace to life and property.

The Bureau conducts the research, supplies the services of the engineers, and provides such facilities and equipment as it possesses. The Association provided $11,500 for the work.

Agreement With Pennsylvania Grade Crude Oil Association

The Bureau and the Association concluded an agreement with the purpose of increasing the production of oil and bringing about a more efficient extraction of petroleum from underground reservoirs by applied technical research. The Bureau agreed to conduct, supervise, and direct technical research under this cooperation, supply the services of suitable engineers and provide such facilities, instruments, and equipment as it possesses for the purpose, and provide office and laboratory space for the work at the Petroleum Field Office in Franklin, Pennsylvania. The Association provided $2700 in 1948 and $500 for 1949.

Agreement With Natural Gas Department of American Gas Association

The agreement provides for cooperation in planning and conducting an investigation of the characteristics of flow in high pressure natural gas transmission lines, in order to develop a more accurate formula for predicting the quantity of gas which can be transported through a pipe line under stated conditions. The work involves a re-examination of previous experimental work on pipe friction and a thorough experimental study of the high gas velocities and pressures common in gas transmission lines. The work will be headquartered at Amarillo, with a large part of the experimental work to be done in the Government's Cliffside Gas Field.

The Bureau supervises the studies, in cooperation with the AGA Pipe Line Flow Subcommittee; provides working quarters in its offices and laboratories; and makes available equipment on hand, as well as furnishing the wells and pipe lines to supply gas for the experimental work. The investigations are planned to cover a period of 3½ years, with a total expenditure by AGA of $67,000.

Agreement With Natural Gas Department of American Gas Association

The Bureau and the Association agreed in February 1947 to cooperate in planning and conducting an investigation of means to remove excess nitrogen —normally defined as about 10 per cent or more—from natural gas to: (1) Increase heating value; (2) increase the effective capacity of transmission and distribution lines; (3) improve marketability and utilization, and (4) obtain related benefits.

The Bureau conducts the investigation at its Amarillo Helium Plant made in accordance with plans by the Bureau and the Nitrogen Removal Subcommittee of the Main Research and Technical Committee of the Association. The Association has provided $20,000 for 1949 toward payment of expenses.

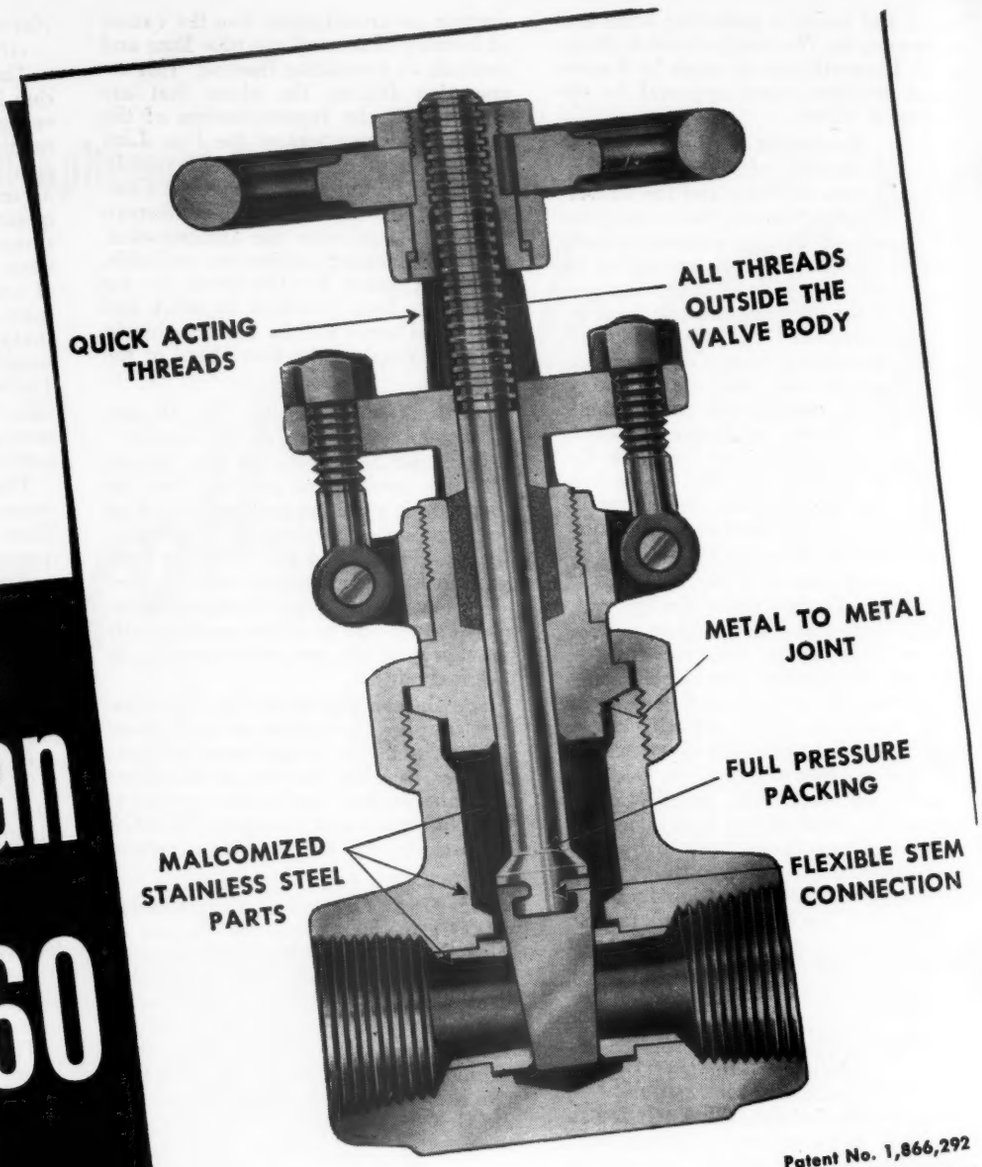
Agreement With the API

Recently, the Bureau entered into a new agreement with the API for conducting fundamental studies relating to sulphur compounds in petroleum, involving: (1) Large-scale synthesis and purification of sulphur compounds and determination of physical and chemical properties; (2) determination of thermodynamic properties; and (3) separation and identification of sulphur compounds in petroleum distillates. The Bureau will supply technical personnel, equipment, and laboratory and office space at Bartlesville and Laramie for the work, to be known as API Project 48A. API has made available $20,800 during fiscal year 1949.

Other Agreements

The Bureau also has entered into cooperative agreements with the College of Physicians and Surgeons of Columbia University and with the Harvard Medical School for studies relating to the medical uses of helium. The Bureau will deliver helium without charge to the two organizations for the studies.

Chapman List 960



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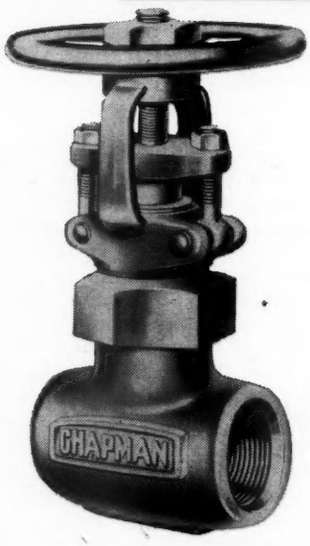

This Chapman List 960 was specifically designed to simplify your maintenance problems. For instance, you can repack it without interrupting service . . . there's no pressure transmitted to the stem. And you can use it inside or out, for a forged steel packing gland protects vital yoke threads from rust and corrosion. To ensure longer wear, seats and plugs are made of superhardened stainless steel . . . body and yoke of tough forged steel.

For your best buy . . . specify the Chapman List 960. Available in sizes from ¼" to 2" . . . carbon steel for pressures to 800 pounds; alloy steel for pressures to 1000 pounds at 750°F. For higher pressures, specify List 990.

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